AIR CONDITIONING HEATING AND VENTILATING

OCTOBER 1960

For the Engineer
Engaged in DESIGN
APPLICATION
ESTIMATING
SPECIFICATION
and LAYOUT

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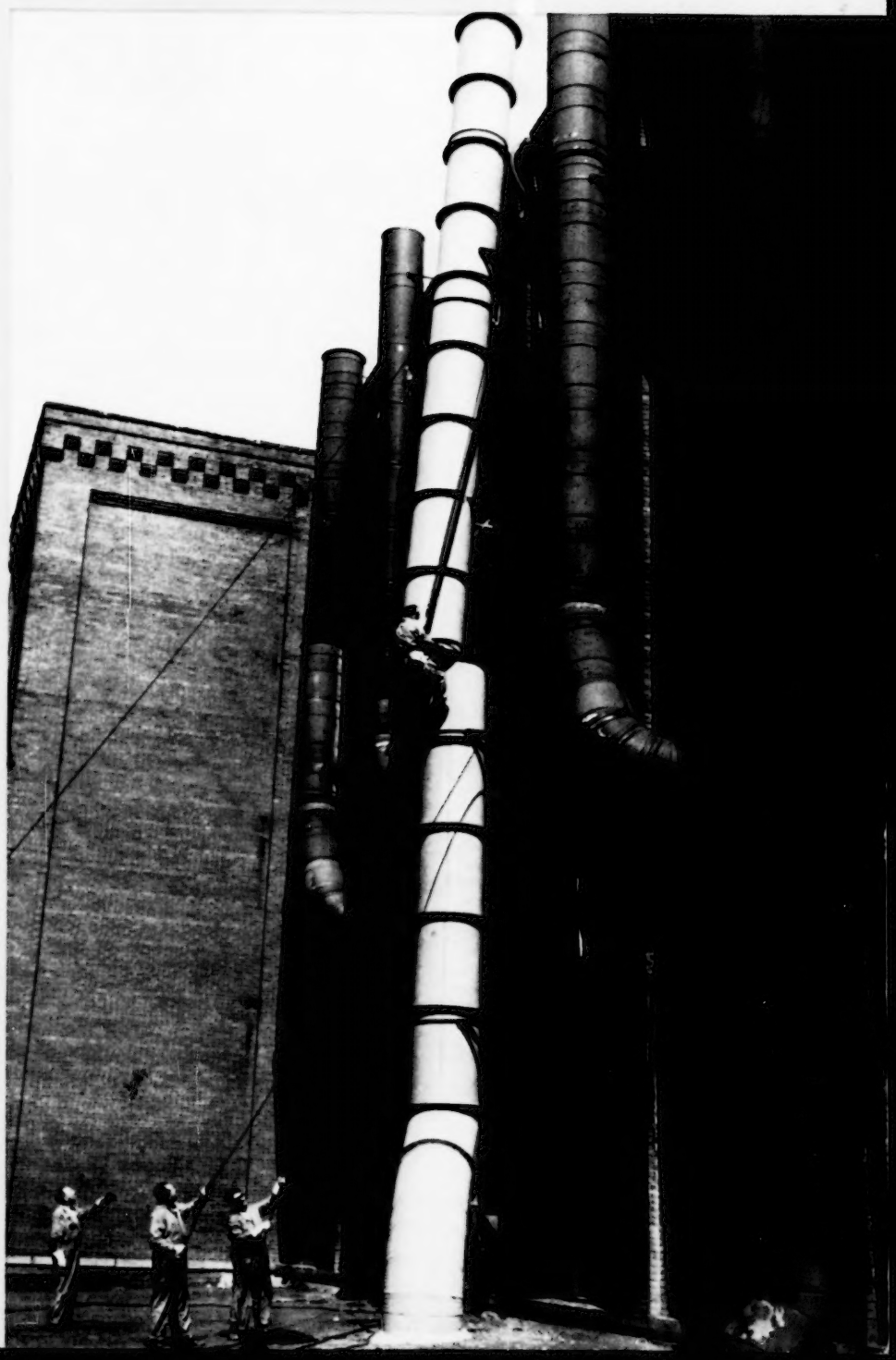
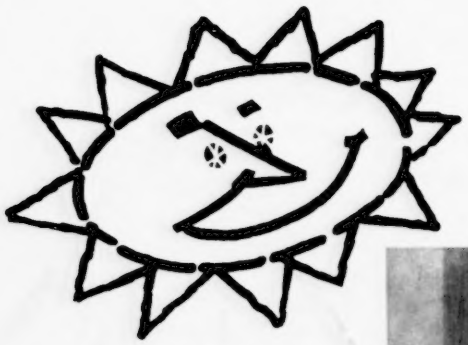
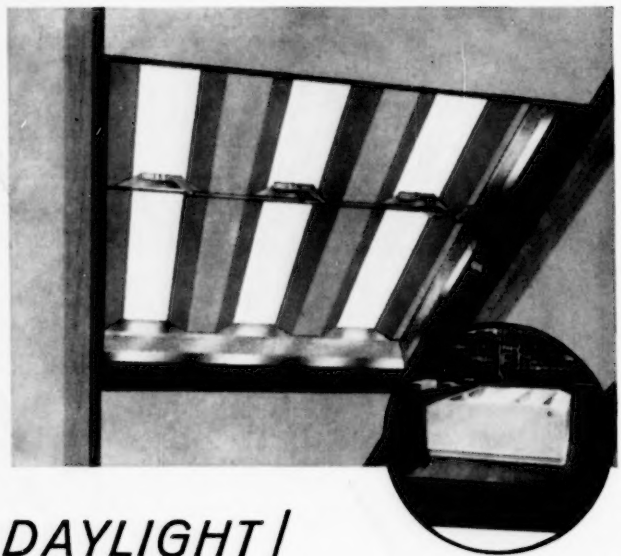


Looking like giant spools of thread stacked 80 ft high, flanged sections of thermoplastic exhaust stack swing into place at The B. F. Goodrich Co., Akron, Ohio. Its Koroseal material is one of several being used in this application. See page 75 for details.



another BRIGHT IDEA from ENGINEERS at PENN



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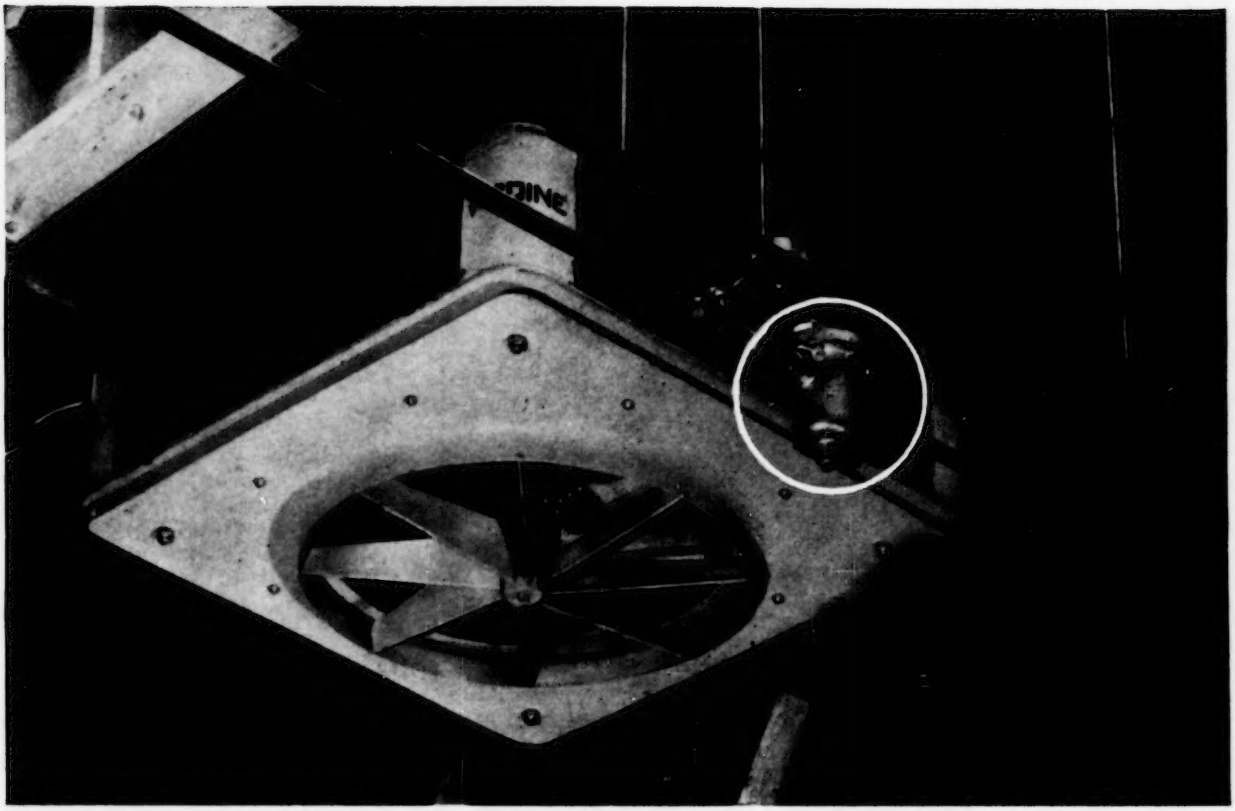
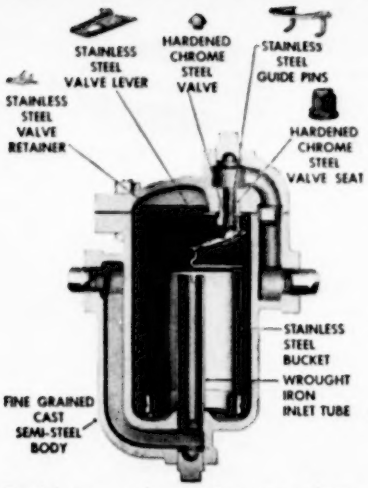


How Corrosion of Unit Heaters is Prevented by Good Trapping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HARDENED CHROME STEEL VALVE
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Cause. Costly corrosion of unit heaters is frequently the result of sluggish condensate drainage and inadequate venting. Any carbon dioxide gas present in the steam supply will go into solution if the condensate is below steam temperature, forming corrosive carbonic acid. Presence of oxygen aggravates the corrosion.

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800 Series, side inlet, side outlet.

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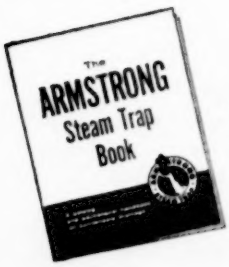

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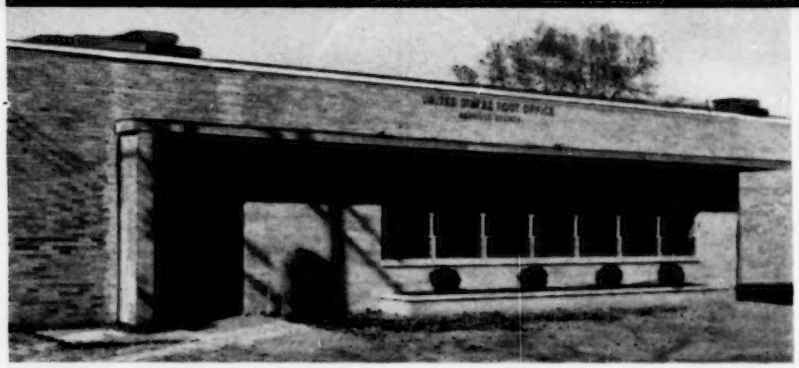

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AIR CONDITIONING HEATING AND VENTILATING

Volume 57, Number 10 **October, 1960**

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COVER PHOTO: This striking installation serves well to introduce one of the relatively new uses of plastics. In structural form, two groups of plastics are being used in corrosive exhaust applications, and they are outlasting their metallic cousins in a way which warrants a review of their characteristics. Our **Reference Section,** beginning on page 75, presents an introduction to these **plastic ventilation products.**

HIGH SPOTS in this issue

DO-IT-YOURSELF: Most engineers have no trouble reading a manufacturer's graph of equipment characteristics. Mr. Neal shows how simple it is to **make your own very useful system graph.** Once the design point has been established, he writes, a few more points are readily found. A graph of a proposed system shows, among other things, effects of aging in pipes, errors in assumptions and computations, design changes, and variable operating conditions. Page 57.

BALANCING: **Balancing a large air system** is a time consuming task. However, through proper planning and test procedure, the man-hours required for this work can be greatly reduced. Systems must be balanced for assurance that air quantities delivered approximate the design figures. See page 69 for this story.

PIPING: Since a physical piping layout is usually required at an early stage of the **nuclear power plant design,** the unusual features involved in this particular optimization require some investigation. An article, beginning on page 66, presents a rational approach to this problem.

FLANGES: The proper selection and use of **forged steel flanges** is the subject of a comprehensive article beginning on page 89. Author Harrington discusses both well-known and not-so-well-known flange types and flange facings, and presents a guide to correct application that tells "why" as well as "where".

AIR CLEANING: Two methods, one analytical and one graphical, are offered to simplify the complex problem of **predicting performance of reverse jet filters** under various operating conditions. Knowlton J. Caplan, one of the pioneer workers in development of this highly efficient air cleaning device, is the author. See page 62.

AIR CONDITIONING: Selecting the type of air conditioning system most economically suitable for a specific application requires an understanding of the functional performance of the various types of systems. Assistance toward this type of evaluation is provided in an article beginning on page 72.

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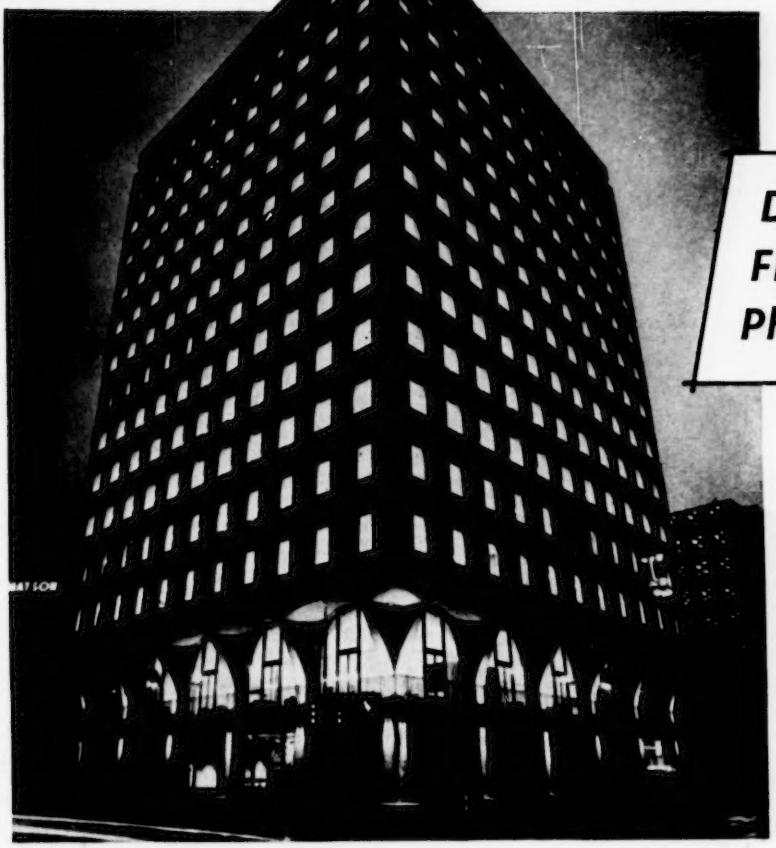

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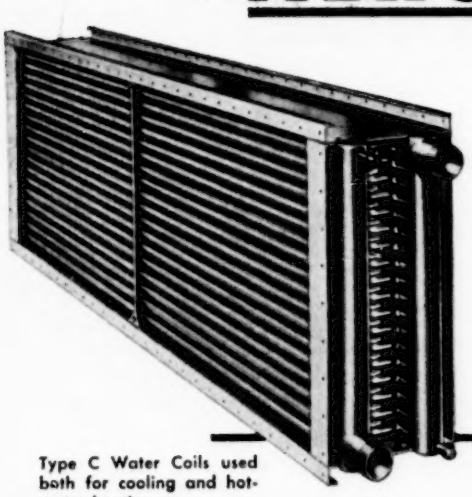

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ENGINEERING OFFICES IN PRINCIPAL CITIES

How *Imaginative Engineering* Put Taming Chicago's

John Dolio (right) in front of Powers Graph-O-Matic Control Panel with E. S. Anderson, engineer for the Illinois Psychiatric Institute.

The unusual temperature requirements specified for the new Illinois Psychiatric Institute presented an extraordinary challenge for John Dolio & Associates. This Chicago engineering firm was asked to provide an absolutely uniform temperature throughout the 11-story, T-shaped building. Because temperature variations cause extreme discomfort —even pain—to mental patients, the system had to be accurate, foolproof and automatic. Because Chicago temperatures rise or fall to extremes within hours—sometimes minutes —the system had to be capable of sensing the changing weather picture outside and automatically and simultaneously reacting inside.

The resulting design provides all the answers . . . in a Powers pneumatic control system that operates automatically 24 hours a day—every day—at a bare minimum of cost; a system that compensates instantly for sudden outdoor temperature changes; a system that can be checked and controlled by one man.

The result is a functional system of control where practical engineering principles were combined by the Dolio firm with a strong helping of ingenuity in order to whip some of the more unusual problems. For example, since chilled water was to circulate through ceiling heating-cooling panels, a safeguard against condensation was necessary. The engineers solved this problem with a series of dew point controls mounted at various locations in the ceilings. Thus, "controls on a control" prevent water temperature from falling to the point at which condensation could occur.

Phil Derrig, Chief Mechanical Engineer of the Dolio firm, inspects one of the dew point controls specially designed to prevent condensation of cold water in the ceiling heating-cooling panels.

Powers Temperature Control To Work Weather At Illinois Psychiatric Institute

Illinois Psychiatric Institute
Chicago, Ill.

Illinois Supervising Architect:
Louis H. Gerding

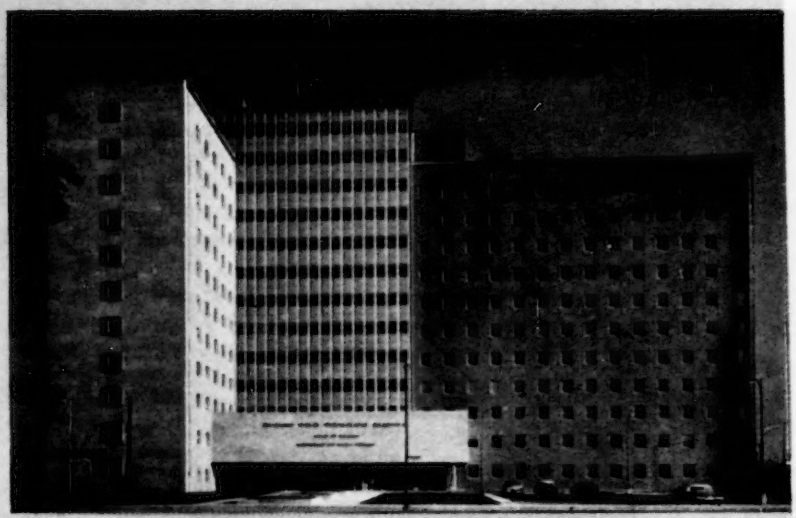
Architects:
Shaw, Metz & Associates, Chicago

Associate Architects and Engineers:
Fugard, Burt, Wilkinson and Orth

Consulting Engineers:
John Dolio & Associates, Chicago

Heating, Air Conditioning Contractor:
Gallaher and Speck, Inc., Chicago

Ventilation: Zack Co., Chicago



JOB DETAILS

The system encompasses 12 temperature zones, each designed to operate independently in relation to individual zone exposure problems. Ten zones utilize ceiling heating and cooling panels at which hot and chilled water circulate from zone exchangers. Three-way control valves for the water are modulated by pneumatic thermostats in various rooms. Two zones — auditorium and stairwell — have only heat exchangers (the auditorium is supplied with individual conditioned air).

Master outdoor controls sense the changes in temperature outdoors and instantly reset submaster pneumatic thermostats at the zone exchangers. These indoor-outdoor controls are engineered for foolproof maintenance of uniform zone temperatures.

A central control board, the heart of the Dolio design, monitors the complete heating, cooling and ventilating system. The building engineer alone can instantly check 170 control points by merely referring to the Powers Graph-O-Matic Control Panel.

Temperature controls are inaccessible to patients. All controls in the corridors are wall-mounted and cabinet-enclosed; temperature sensors are mounted in ceiling exhaust ducts.

Easy servicing and low maintenance are two big reasons why a pneumatic system of control was specified by this engineering firm. Efficiency at low cost is characteristic of this type of control — as it is with the Powers pneumatic system installed here.

Safety and comfort for patients is provided for throughout. For example, in hydrotherapy, in showers, in sitz baths, etc., Powers Hydroguard® thermostatic water controls prevent scalding and eliminate dangerous water temperature fluctuations.

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NEWS OF THE MONTH

CLEANER AIR WEEK (OCT. 23-29) TO ALERT PUBLIC INTEREST

Cleaner Air Week, which has won the endorsement of President Eisenhower and of civic, government and industrial leaders throughout the nation, is broadening its horizons this year.

Sponsor of this drive to focus attention on the nation's search for better air is the Air Pollution Control Association, headquartered at Mellon Institute in Pittsburgh, Pa. APCA promises a greatly expanded range of activity during this year's Cleaner Air Week, which begins on October 23, and appeals to all elements of our society to take an interest in the observance.

Industry Leading the Way

It should be particularly noted, APCA states, that while thousands of communities have adopted legislation to curb air pollution, industry is leading the way with the installation of an estimated $300 million worth of dust collectors, air filters, air washers and electrostatic precipitators every year. With modern, specialized equipment it is no longer necessary, according to the experts, for any plant of any sort to contaminate the air, offend the nostrils or even dirty the wash of its neighbors.

"The twelfth annual observance of Cleaner Air Week emphasizes the continuing need for greater public effort to solve the problems caused by the hazard of air pollution. This year there are indications of a renewed awareness of the seriousness of air pollution as a threat to human life and property," says President Eisenhower in his 1960 message to APCA. "Activities connected with Cleaner Air Week call attention to the importance of the research and control programs carried out by private and governmental groups. By these means the public is reminded that air pollution is an individual and community problem—its solution is everyone's gain," said The President.

First Utility-Operated Central Plant To Heat and Cool Hartford Office Buildings

America's first utility-operated central plant to supply both steam for heating and chilled water for cooling will be built in downtown Hartford, Conn., this fall, F. H. McGraw & Company, New York, N. Y., who have been awarded the contract to build it, announced.

To cost $3-million, the plant will be an ultra-modern structure erected primarily to serve the commercial buildings now under construction in Hartford's $50-million urban renewal project, Constitution Plaza.

The central plant, a significant development in the architecture and building fields, makes it unnecessary for Constitution Plaza and other new buildings in the area to provide their own individual heating and air conditioning plants.

6,000 Bhp Capacity

Initially the plant will have a capacity of 100,000 pounds of steam per hour which will eventually be doubled and will be equal to 6,000 boiler horsepower. Besides heating, the steam generated will operate 9,000 tons of refrigeration equipment to supply chilled water for air conditioning.

To give maximum attractiveness, the architect, Charles DuBose of Hartford, will make liberal use of glass and ceramic products in the 200-ft long structure, actually two buildings connected by a walkway, one of which will house boilers and chilled water equipment while the other, a circular structure, will house the control room and offices. A pumping system will supply water for cooling the condensers from the adjacent Connecticut River.

W. T. Jebb, president of Hartford Gas Company, said the project's construction schedule will be geared to the requirements of Constitution Plaza. Seelye Stevenson Valve & Knecht, New York City, are the consulting engineers.

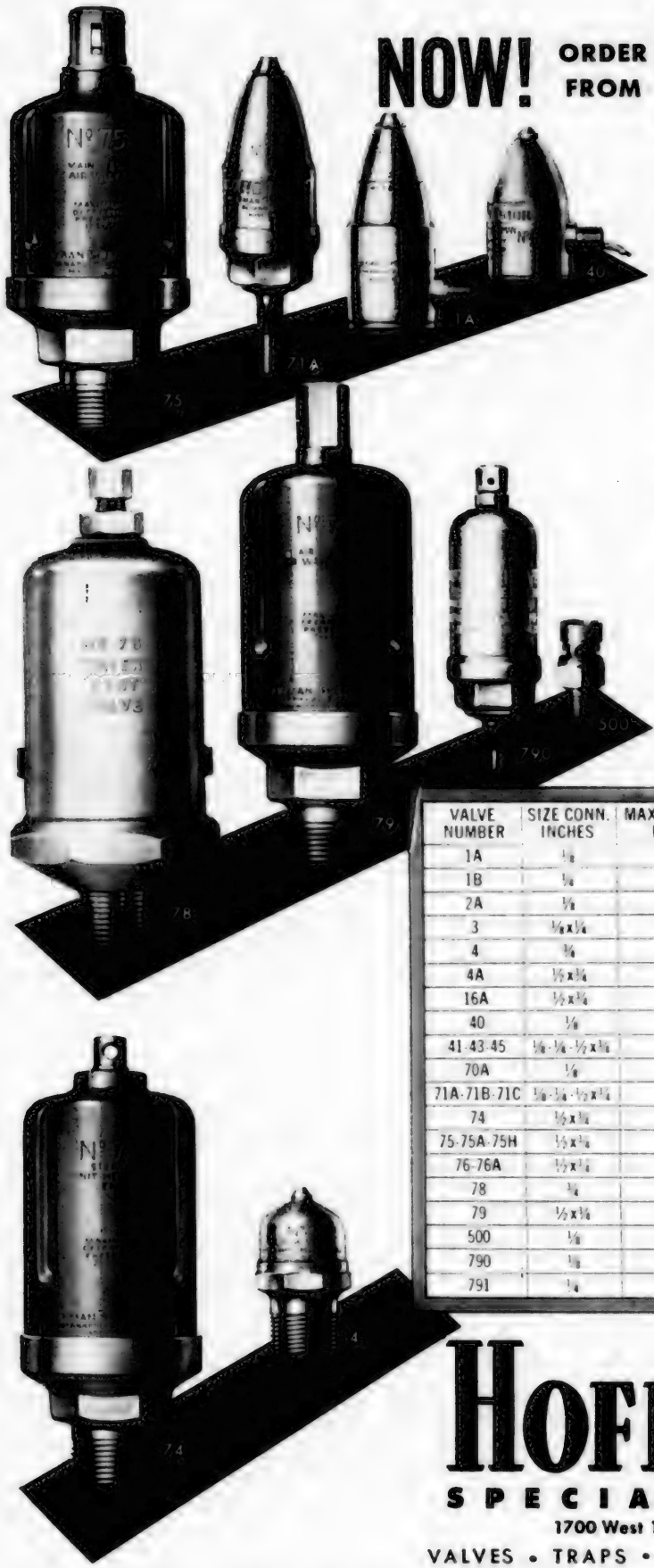
Coin-operated dry cleaner is making its first nation-wide debut. Developed at Whirlpool Corporation's research labs in St. Joseph, Mich., fifty of these machines will be in public use in twenty American cities, each maintained by a professional dry cleaner and, in most cases, installed in a coin-operated laundry. Dry cleaner will clean 8 lb of clothes in approximately 50 min at a cost of about $1.50. This is said to represent a savings of from three to six dollars for quantity items as shirts, slacks, sweaters and suits.

CONSTRUCTION CONTRACTS UP FOLLOWING A SLOW START

After a slow start, construction contracts rebounded nicely in the first half of 1960 and by June reached a point not too far below the high levels of last summer, F. W. Dodge Corp., New York, N. Y., reported.

In a midyear review of construction contracts published in its monthly bulletin, *Building Business*, the Corporation's economists

(Continued on page 10)



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1A	⅛	10	■		■		
1B	⅛	10	■			■	
2A	⅛	10	■		■		
3	⅛x¼	25	■		■		
4	⅛	25	■				■
4A	⅛x¼	10	■				■
16A	⅛x¼	10	■				■
40	⅛	10	■		■		
41-43-45	⅛-¼-½x¾	10	■			■	
70A	⅛	15	■		■		
71A-71B-71C	⅛-¼-½x¾	15	■			■	
74	½x¾	35	■				■
75-75A-75H	⅛x¼	15	■				■
76-76A	½x¾	15	■				■
78	¾	150		■			■
79	½x¾	75		■			■
500	⅛	50	■	■	■	■	
790	⅛	30		■		■	■
791	¼	50		■		■	■

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CONSTRUCTION CONTRACTS

(Continued from page 8)

pointed out that non-residential building contracts in the first six months of this year reached the second highest first-half total in history, while heavy engineering contracts dropped slightly below last year and residential contracts were down a sizeable 14%.

Noting that the decline in residential contracts was generally expected and that recent reports indicated that the mortgage market may be gradually loosening up, the report said:

"If there is some second-half gain in housing, and there should be, coupled with the improvement occurring in contracts for non-residential building and heavy engineering, 1960 will wind up as a pretty good year for the construction industry, although it is not likely to be a record-breaker."

AIR CONDITIONERS CLEARED IN SPREAD OF FATAL MONOXIDE

Alderman Charles Weber, 66, of Chicago's 45th Ward, and his wife, Emma, 60, were found dead August 16 in their home at 3601 North Wolcott Avenue, where they had apparently died of carbon monoxide fumes. Source of the fumes was an idling automobile engine in an attached garage. It was thought that the fumes had been drawn through an overhead hatch and distributed by ducts of an air conditioning system to the bedroom where the bodies were found. The house, a big bi-level structure with attached two-car garage, had been built by the Webers only three years ago.

Trapdoor in Ceiling Open

The first policeman arriving at the house found one of the Webers' two cars still warm, the ignition turned on, and the gas tank empty.

A trap door in the ceiling of the garage leading to a crawl space under the roof was open and the police said that fumes from the automobile had apparently spread through the attic and then been pulled into the house by a central air conditioning unit in the basement. All windows in the house were closed. Three dachshund dogs were found dead in the basement utility room. Police said the house was full of auto exhaust fumes when they arrived in response to a call from one of the Webers' friends who became alarmed when there was no answer to his repeated telephone calls.

Alderman Weber, Democratic committeeman of the ward since 1930 and a former county commissioner and state representative, was born in Chicago. As Alderman he held a "kids' day" picnic every year at an amusement park. His party this year was scheduled to be held August 27 and he had talked to police authorities about details of the occasion the day before his death.

Jury Finds Code Violation

A coroner's jury which ruled that Weber and his wife had died accidentally of carbon monoxide poisoning said also that the Weber house violated the Chicago building code. The hatch in the garage ceiling giving access to the general attic space was a violation. The jury recommended that all building codes require physical isolation of the garage from habitable quarters by permanent vertical construction and ventilation of all

(Continued on page 12)

Exposition to Preview Advances In Power Plant Control Systems

Automatic intelligence systems for regulating the overall performance of power plants will be among the outstanding developments exhibited for the first time at the 24th National Exposition of Power and Mechanical Engineering, which is to be held at the New York Coliseum November 28 to December 2.

"Sophisticated" Systems

The biennial Power Show will feature "sophisticated" control systems designed to analyze individual operations and regulate controls to secure optimum economy in the overall plant operation.

Another line of control specialties consists of miniature air and hydraulic cylinders, push-pull airline couplers, pneumatic valves and accessories. These units are applied in complete air control systems and also in automating industrial production machinery. Electrical communication and control systems will be exhibited in many forms.

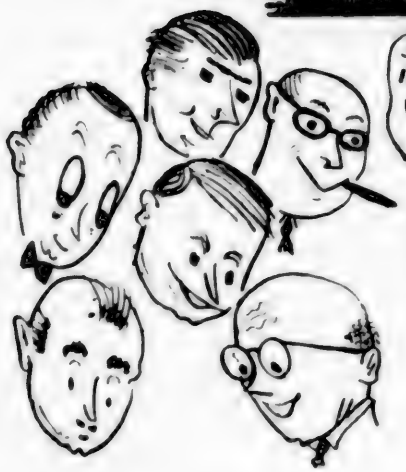
A line of heavy duty triplex pumps will offer such features as total enclosure, integral double-reduction gearing and the elimination of packing in the high-pressure end. They are designed for pressures up to 20,000 psi, will operate at temperatures from minus 320 F to plus 1,000 F, and will handle a range of fluids from water to Freon, solvents and heptane. Pumps of this description are of interest to steel mills, metal fabricators, plastic and rubber molders and other industries using water for hydraulic power; also for the aircraft, missile and chemical industries, which require high-pressure pumps for exotic fluids.

Super Stainless Steel

Indicating the increased demand for high resistance to corrosion, a steel company is bringing out a super stainless steel for resisting hot sulfuric acid. The material is available in pipe, tubing, strip, sheet, plate and bar.

As heretofore, the Exposition will be held under the sponsorship of the American Society of Mechanical Engineers in conjunction with its Winter Annual Meeting in New York. It will be under the management of International Exposition Company, 480 Lexington Ave., New York 17, N. Y. E. K. Stevens is the manager.

NO NEED FOR CUSTOM JOB



Get the most from your Pump investment

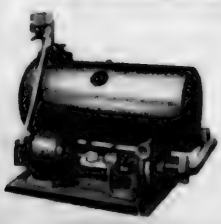
A standard type Skidmore Pump will meet the exacting requirements

There's a wide range of types and capacities for every heating pump need. Let Skidmore advise you on your next tough job.

TYPE UV

Type UV Condensation Pump is designed for below floor level returns, and is built in single and duplex units.

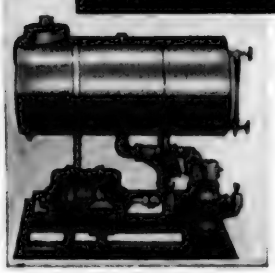
Write for *Bulletin No. 19-A*



TYPE HS

Type HS Pump is recognized for its dependable low operating cost. Capacities range from 1,000 to 65,000 sq. ft. EDR and pressures from 10 to 75 pounds.

Write for *Bulletin No. 14-A*

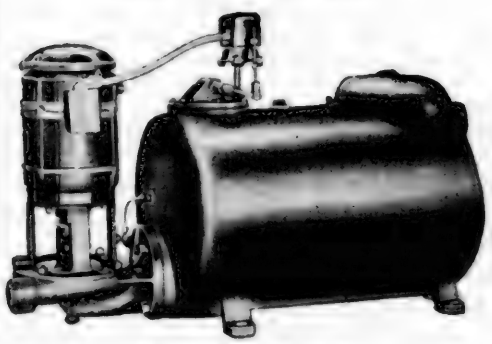


TYPE TM

Type TM High Pressure Turbine Pump. Designed for pressures up to 150 pounds and boilers to 250 H.P.

Write for *Bulletin No. 17*

SKIDMORE TYPE "CCVS"
Vertical Condensation Pumps



SKIDMORE TYPE "VC"
Condensate Pump and Receiver

Sales representatives in principal cities . . .
Call or write for bulletins.

SKIDMORE CORPORATION ST. JOSEPH, MICHIGAN

AIR CONDITIONERS CLEARED

(Continued from page 10)

garages by adequate and permanent means.

An air conditioning expert testified that the central air conditioning unit in the Weber home had no part in transmitting the carbon monoxide fumes through the house. He said the auto exhaust fumes rose through the garage ceiling into the attic and seeped through plaster cracks and openings into the bedroom area.

Code Revisions Advocated

Revision of building codes for Chicago and suburbs to compel certification of licensed engineers for home air conditioning systems was advocated by Ralph J. Abramson, chairman of the Safety Committee of the Chicago Association of Consulting Engineers. Abramson and Gerald Marks, president of the Illinois Society of Professional Engineers, were among experts detailed to examine the Weber home after the accident.

A year previously, Abramson and Marks were members of a blue ribbon coroner's jury which recommended building code revisions as a result of a finding that a faulty installation of an air conditioning system contributed to the deaths of James W. Franklin, a Celotex Corporation executive, and his wife in their Evanston home. A requirement for the certification of the air conditioning plans by licensed engineers was one of his specific recommendations made at that time for code changes in the Chicago area. Mr. Abramson pointed out that the present building codes did not specify any qualifications for persons installing air conditioning systems.

Conference To Review Progress In Preassembly of Building Components

Said to be the biggest factor in reducing the cost of buildings, the use of pre-assembled large building components to replace slow and costly on-site construction is making advances throughout the building industry, according to Building Research Institute. To bring together all of the current experience with components, and to get the viewpoints of architects, home builder, contractors, building owners and operators, building code officials and labor, BRI will hold a comprehensive conference on the subject during its forthcoming 1960 Fall Conferences, Nov. 15-17, Shoreham Hotel, Washington, D. C.

Speakers in each of the categories named above will take the stand to express the attitude of their particular groups to the increased use of preassembled building components of all types and varieties. The principles of preassembled component construction for residential and nonresidential buildings, will be set forth by home builders, architects, component manufacturers, prefabricators and material dealers, and a number of case studies of the actual use of large components, their cost, performance, appearance and durability, and problems encountered with their use will be described. Included also will be mechanical components such as preassembled utility cores and electrical systems.

Complete program and registration material may be obtained from Harold Horowitz, BRI assistant director for technical programs, National Academy of Sciences-National Research Council, 2101 Constitution Avenue, N. W., Washington 25, D. C.

NATIONAL WARM AIR MEETING SET FOR NOVEMBER IN CLEVELAND

Based on the theme, America's Goal for '61 — Indoor Comfort for Everyone, the 47th National Convention of National Warm Air Heating and Air Conditioning Association has been set for Monday through Wednesday, November 14-16, at the Statler-Hilton Hotel, Cleveland, Ohio.

Scheduled are: dealer-contractor sales and marketing forum, application engineering session, manufacturers' marketing session, and others. The application engineering session (Tuesday, Nov. 15) is open to all segments of the industry. Evaluation of current research in the Association's Research Residence No. 4 will be tied to discussions of other subjects of pertinent interest to the industry, it was reported.

Advance registration, with billing directly to the person's business address, will be made available for the first time this year, according to Managing Director James M. Martin, 640 Engineers Bldg., Cleveland 14.

NEW ANTHRACITE BURNERS SHOW HIGH TEST RATING

Heating efficiencies of several small industrial-type anthracite-burning automatic stokers have exceeded claims made by manufacturers at both high and low capacities of the boilers, according to recent test information released by the United States Bureau of Mines. The burners have recently been put into mass production and are offered as separate equipment for conversion of existing boilers.

Heating efficiencies were as high as 82% under continuous firing at ratings of 50 to 87% of the optimum fuel rate. Even at only 30% of optimum fuel rate, heating efficiency was in excess of 75%. Performances were measured in accordance with the ASME test code.

New Gravity Feed Burners

These results were achieved on newly developed gravity feed inclined water cooled grate burners manufactured by both the Losch

(Continued on page 14)

With a draft diverter these are
nothing but smoke stacks.
Specify instead a
FIELD DRAFT CO L
ane ncy becom
chimneys
nt, unfailing ce
cisely control to
f gas combu
field
Engineering Works, In ota, Illinois
Material Handling Division · Cranes, Hoists · Co Inc · Brick, Tile, Ston

NEW ANTHRACITE BURNERS

(Continued from page 12)

Boiler Company of Summit Station, Pa., and Electric Furnace Man Inc., of Emmaus, Pa.

Heating engineers connected with the Anthracite Information Bureau pointed out that the heating efficiency results printed in a 57-page Bureau of Mines Report (RI 5607) were even higher than those generally attributed to this equipment. Highest efficiencies previously claimed had been approximately 80%.

Stoker Efficiencies to 82 Percent

The performances of the stokers tested were observed with identical 74 hp steam boilers. Fifty runs of 12 and 24 hours' duration were made in accordance with the ASME test code.

Peak efficiencies of 82% were recorded at 68 and 73% of rated boiler capacity. The curves also were symmetrical on either side of the peak axes. The Losch curve showed efficiencies above 80% at heat outputs of 1,150M to 2,220M Btu and the E.F.M. curve at heat outputs of 1,350M Btu to 2,330M Btu.

Per cent of combustible in the ash ranged from 12 to 30%, representing a loss of approximately 500 Btu per pound of fuel fired, or an actual loss of efficiency of from 4 to 5%. Anthracite coals used in these tests ranged from 11,840 Btu to 12,560 Btu per pound.

Grates Are New, Too

The gravity feed and inclined water cooled grate used in both the Losch and E.F.M. burners is of comparatively recent design. First developed after World War II, its original design capacity has been increased from 7,200 sq ft of EDR steam to capacities in excess of 20,000 sq ft.

The grate consists of flat steel plates, angled 7.5 deg from the horizontal feed end to the discharge end. The plates are ¼ inch steel plate with 3/32 inch air jets drilled on ¾ inch centers. There are 256 of these air jets to the square foot of burner surface. As a result of maintaining a thin fuel bed, a continuous high burning rate can be sustained without the development of excess air as a result of uneven distribution in burning.

A water chamber ¾ inch deep located under the grate is supplied by water from the boiler through flexible connections. The water reaches the grate at the upper end and is circulated by gravity into the boiler below the water line. This preheats the water and largely accounts for the greatly increased output of the boilers. In many cases output of the boiler is increased by some 10 to 15%. Application is limited to low pressure heating boilers. The water-cooled grate eliminates moving parts in the burning zone and circulation of water helps prevent the grate from burning out.

The heating efficiency tests made on the Losch and E.F.M. burners were conducted by R. F. Tenney, supervisory chemical engineer, Anthracite Experiment Station, Bureau of Mines, Schuylkill Haven, Pa., and J. W. Eckerd, chief, Branch of Utilization and Preparation, Anthracite Experiment Station, Bureau of Mines, Schuylkill Haven, Pa. They were assisted in the preparation of their report by A. F. Baker, fuel technologist, and J. D. Sieck, foreman-operating engineer, Anthracite Experiment Station.

Dr. A. C. Willard Dies at Eighty-Two; Noted Engineer, Educator, and Author

Dr. Arthur Cutts Willard, 82, University of Illinois president emeritus and one of the nation's leading air conditioning, heating and ventilating engineers, died at midnight, September 11, in McKinley Hospital, Urbana, Ill.

Recipient of the F. Paul Anderson gold medal of the American Society of Heating and Ventilating Engineers in 1936, Dr. Willard had been the Society's president in 1928. His tenure with the University of Illinois began in 1913. By 1920 he was head of the mechanical engineering department, acting dean of its College of Engineering and Director of its Engineering Experiment Station in 1933, and president of the university from 1943 to 1946.

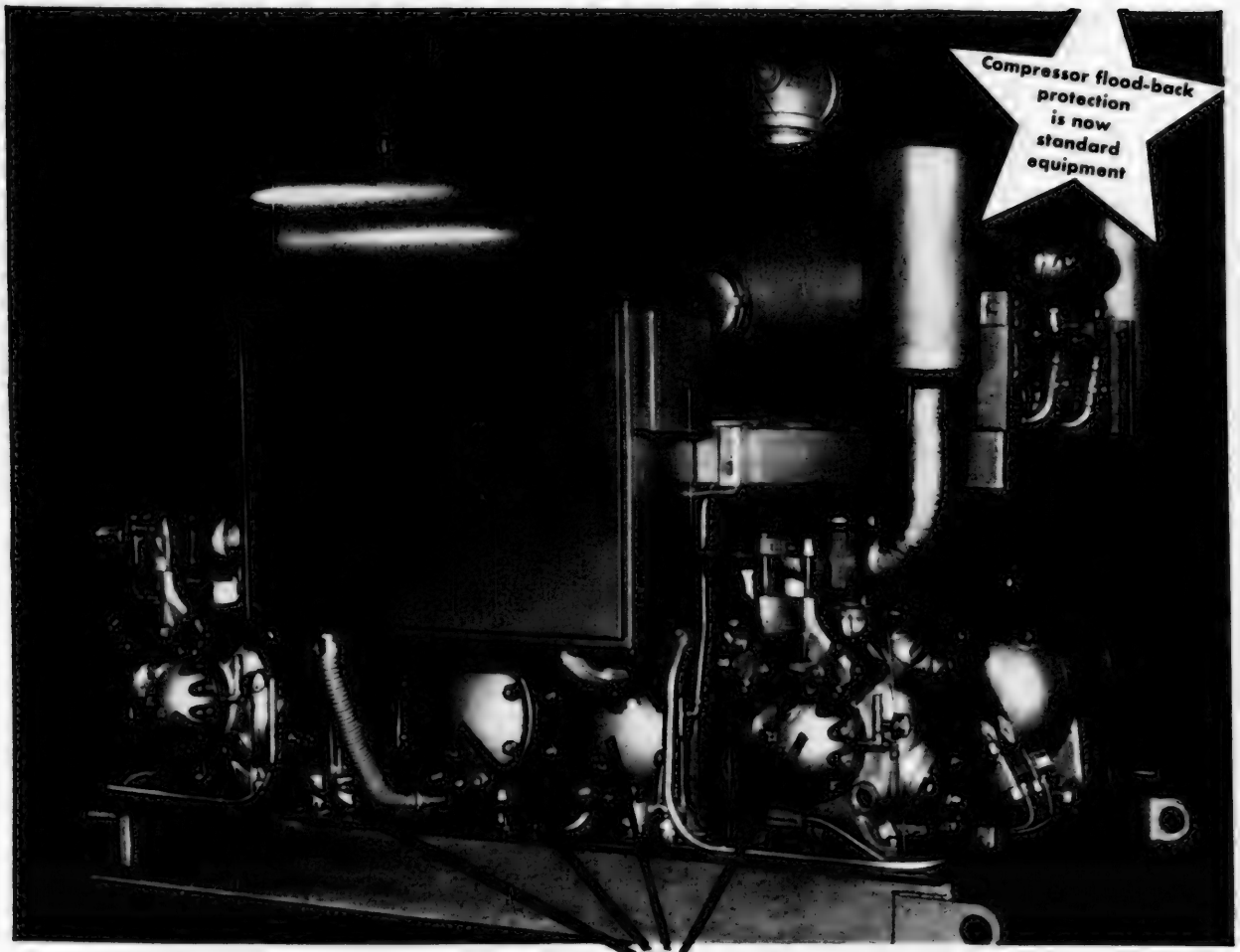
Dr. Willard was a consultant to several governmental agencies, helped design the Holland Tunnel between New York and New Jersey, and authored several books in the fields of air conditioning, heating and ventilating.

ADVISORY COMMITTEE NAMED FOR CHICAGO EXPOSITION

Announcement has been made of the advisory committee for the 15th International Heating & Air-Conditioning Exposition, to be held at the International Amphitheatre in Chicago February 13-16, 1961. Named as chairman is Walter A. Grant, president of the American Society of Heating, Refrigerating & Air-Conditioning Engineers, under whose auspices the Exposition will be held.

Membership on the committee of thirty-three includes members of

(Continued on page 134)



NOW 2 COMPLETE CIRCUITS IN ONE COOLER

Another example of B&G creative engineering!

The B&G Package Liquid Cooler is now available *with two complete refrigeration circuits*...dual compressors, dual condensers and a single evaporator! It has a capacity reduction to 25%—in stages of 100, 75, 50 and 25%. All operative and safety controls are installed and pre-wired.

An outstanding feature is the automatic lead-lag selector switch. In operation, No. 1 motor and compressor handle the load until cooling requirements are satisfied or until No. 2 unit needs to be called into use.

On the next starting, No. 2 unit picks up the load. Therefore each motor and compressor gets equal usage. This dual arrangement is also valuable because it provides stand-by protection in case of emergencies.

Remember, too, that all major parts of B&G "package" units are manufactured and guaranteed by Bell & Gossett Company...*one* responsibility for satisfactory operation.

Send for complete specification and application data on B&G Air Conditioning and Refrigeration equipment.

BELL & GOSSETT
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A FULL LINE OF REFRIGERATION AND AIR CONDITIONING "PACKAGES" AND COMPONENTS

B&G Evaporator

B&G Centrifugal Pump

B&G Condenser

B&G Condensing Unit

The MARSH way is the SURE way—

You'll have a new conception of how *uniformly good* radiator valves, traps and vents can perform when you make the job Marsh all the way through.

Take the Radiator Valve and Trap illustrated here, for instance:

The Marsh Radiator Valve is *truly* packless—not just *called* packless. This valve has no "packing" whatever... instead, the ingenious Marsh annular mechanical seal that keeps it drip tight throughout its far longer life.

And Marsh Radiator Traps are equally sure-footed... have the famous Marsh Diaphragm—extremely rugged, but so sensitive that it never fails to close tight on steam, yet opens instantly to pass condensate and air at only a few degrees below closing temperature.

Yes, the Marsh way is the sure way... Valves, Traps, Vents, F & T Traps, designed, built and tested to give lasting satisfaction in the Marsh tradition. Ask for up-to-date Heating Specialties Catalog 76-H.

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8407 103rd St., Edmonton, Alberta, Canada

MARSH *Heating Specialties*
SINCE 1865

New development in air dynamics...

airfoil centrifugal fan performance in half the space

HERE IS NEWS!

NOW you can have today's airfoil centrifugal fan performance without sacrificing space.

Here are the facts in a nutshell.
We have developed a fan with **in-line** air flow,
and the performance characteristics
of the airfoil centrifugal fan.
But it is smaller by as much as 50 per cent.

And think of the added space you can save with in-line ductwork . . . saves **more** than ½ the installed space over conventional centrifugal fans.

We call our new straight-flow centrifugal fan the **CENTRILINE** fan.

Now, from Westinghouse, you have a choice of centrifugal fan configurations—
the conventional scroll shape, or
the new **CENTRILINE** fan shape for in-line air flow.

Tear out this specification page and save it.
And send the postcard for the catalog.
You'll probably need it soon.

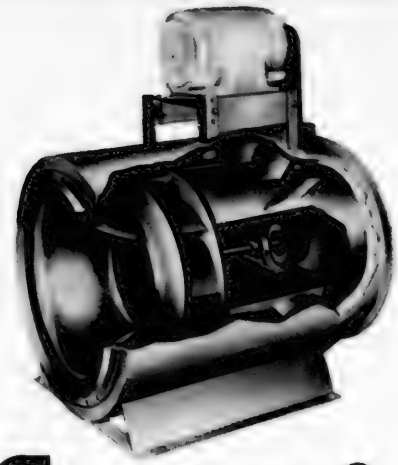
Sturtevant Division, Boston 36, Massachusetts.

You can be sure . . . if it's Westinghouse

Westinghouse

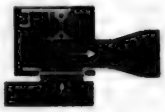
FOLD OUT ▶

This is what the centriline® fan looks like



and here are its advantages...

compactness To do a job that would take a conventional fan this big you need a CENTRILINE fan this small

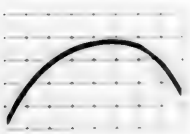
in-line air flow means additional space saving. It allows you to do this instead of this 

fan-mounted motor Makes it possible to hang CENTRILINE fans from the ceiling

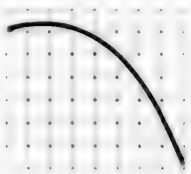
or stack them or mount them on the wall as well as mount them on floor or platform

quiet The CENTRILINE fan performs with the same relative quietness as conventional airfoil centrifugal fans. The secret is a Westinghouse exclusive airfoil bladed wheels and newly developed conversion vanes

inlet equals outlet Inlet and outlet are the same size. You can use one size of duct, making installation simpler



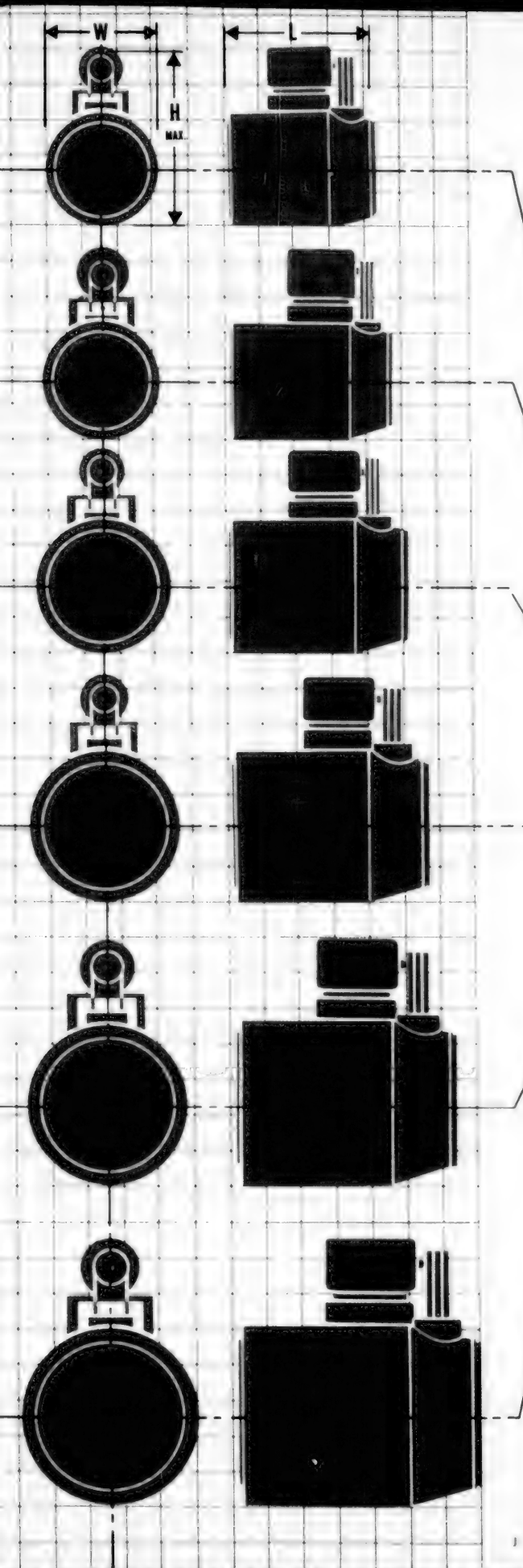
high, broad efficiency curve Translated into money, this means lower horsepower requirements and lower operating costs over a broad selection range



stable pressure-volume performance Means the kind of precise control necessary for conventional air conditioning systems as well as the high-pressure, high-velocity systems of the future . . . plus a myriad of industrial applications.

standard specifying tables Since the inlet and outlet dimensions of the CENTRILINE fan are closely comparable to those of a conventional centrifugal fan of the same wheel diameter, specifying the right size CENTRILINE fan and motor requires no new set of standards or computations. **WE'RE READY TO TAKE YOUR ORDER ON SIX SIZES OF CENTRILINE FANS . .**

® Westinghouse Trade Mark



For a graphic demonstration of the space you can save, use these templates when you design your next fan installation.

CENTRILINE FAN SIZE	WHEEL DIAMETER	DIMENSIONS IN. L	H MAX	W	VOLUME RANGE CFM	SIZE OF EQUIVALENT SERIES 9000 AIRFOIL CENTRIFUGAL FAN SWSI
227	27	49 5/8	60	36 3/4	4700 to 18,000	8027
230	30	51 7/8	65	40 1/2	5700 to 22,000	8030
233	33	59 7/8	69	44 3/4	6800 to 26,000	8033
237	36 1/2	65 7/8	76	49 3/8	8300 to 31,500	8037
240	40 1/4	73 5/8	82	54 5/8	10,300 to 39,000	8040
245	44 1/2	80 1/2	90	60 7/8	12,300 to 46,800	8045

Static pressures up to 9" of water.

SCALE: 1/4" = 1'

Dimensions are in inches and approximate.
Do not use for construction purposes.

J 80706

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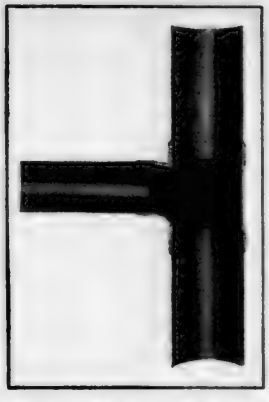
Unretouched photo of 3" dia. copper tube removed after 13 years' service in a soil line.



Anaconda drainage fittings are designed to match Anaconda tube for fast, easy solder connections.

WASTES FLOW FREELY IN COPPER DRAINAGE SYSTEMS AND YOU SAVE MONEY. Compare the condition on the inside of this copper tube with what you might expect to find in ordinary piping after 13 years in service. Rust-caused troubles such as reduced flow or stoppages do not occur inside copper drainage lines. That is why many plumbing codes allow the use of 3" diameter copper tube for soil line and vent. Material costs are reduced and, because a 3" copper tube stack with fittings fits inside a standard 4" partition, the need for expensive, space-consuming plumbing walls is eliminated. Save time, effort, and money—install the modern drainage system with Anaconda copper tube and fittings. For information, write: Anaconda American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

ANACONDA®

COPPER TUBE AND FITTINGS for soil, waste and vent lines

Available through plumbing wholesalers. Anaconda American Brass Company

Longer Lengths—Fewer Joints

Preassembly—Saves Time

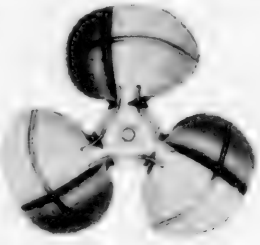
Lightweight Copper—Easier Installation

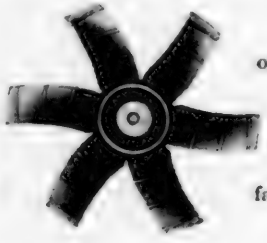
Compact Connections—Save Space

TRANE announces

Duct type propeller fan is a heavy-duty axial fan for moving clean or contaminated air. Installed anywhere in the duct system. Model B fan blades. Available in 16″, 20″, 24″, 30″, 36″, 42″ and 48″ sizes. Direct drive type for simplicity, economy—or with belt drive for flexibility. Totally enclosed motors.

TYPE A BLADE is designed for general ventilation and exhaust. For low pressure applications. Features all-aluminum blades. 20, 25 and 30 degree blade angles for more versatile selection.



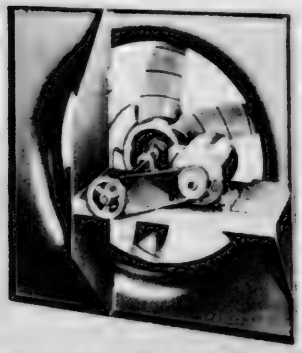


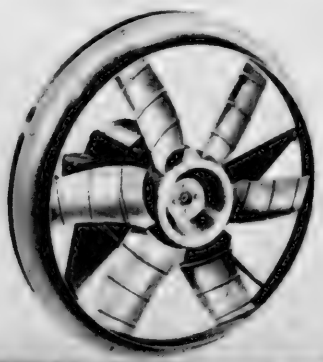
TYPE B BLADE is heavy-duty, to operate against pressures up to 1″. Large, spun-steel hubs. Main steel blades are electrically welded to a secondary steel blade. This makes for sturdy assembly, well equipped to withstand the stress of higher pressures. 3 or 6 bladed fan wheels; 10, 15, 20 or 24 degree angles.

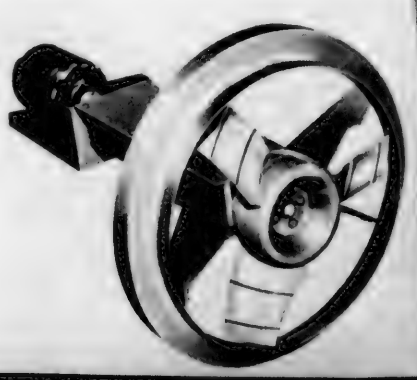
TRANE panel fan may be mounted on walls, ceilings or partitions. Model B blades are available in 36″, 42″ and 48″ sizes—belt or direct drive. Model A blades available in 11¼″, 13½″, 16¾″ and 19¾″—direct drive only. 25¼″ and 30″, in either belt or direct drive.

Orifice fan handles air through short duct runs; installed at duct inlet or outlet (or on wall). Model B blades; sizes: 16″, 20″, 24″, 30″, 36″, 42″ and 48″—belt or direct drive. The TRANE Orifice Fan is designed for a wide variety of both commercial and industrial applications.

Extended shaft fan is used where air or gas is handled at high temperatures; where air is very dirty or corrosive; to exhaust contaminated air. Model B blade type, direct drive, in 16″, 20″, 24″, 30″, 36″, 42″ and 48″ sizes.







—a new line of propeller fans with 266 standard combinations!

They're versatile. They're efficient. And they meet more air handling requirements—accurately!

Here is a big, complete line of propeller fans for industrial and commercial applications —from TRANE, leaders in fan design for over thirty years. These new axial flow fans will meet a wide variety of needs: dissipating fog over dye vats; exhausting fumes from pickling vats, welding smoke from fabrication areas; ventilating paint shops, chemical laboratories, oven rooms, factory and commercial offices, kitchens, laundries and other areas.

There are nine basic fan types in this new TRANE line; 2 blade types, seven blade angles; a total of 266 combinations with standard models to meet the most exacting specifications! And these propeller fans are economical: low in initial cost, low in operating cost. They're more efficient, too; capable of operating against higher resistant pressures. A major design feature on panel, orifice and extended shaft fans is the extended spun orifice ring that funnels air smoothly into the fan wheel to prevent turbulence, air leakage; assures a smooth air flow off the blades.

Developed in the TRANE "House of Weather Magic," these fans have been extensively tested in accordance with AMCA and ASHRAE standards. Sound tests, overspeed tests, pressure tests, have proven them dependable and rugged. And *every* fan wheel is given a running balance test to assure even, vibration-free performance.

WANT MORE FACTS? For specifications on the complete TRANE line of fans, just call your nearby TRANE Sales Office. Or write TRANE, La Crosse, Wisconsin.

For any air condition, turn to

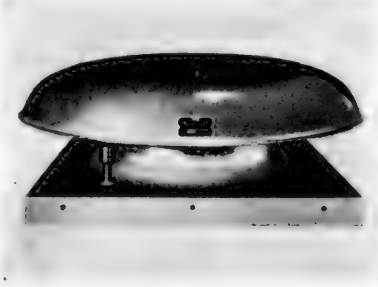
TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA
CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA LIMITED, TORONTO
100 U. S. AND 19 CANADIAN OFFICES

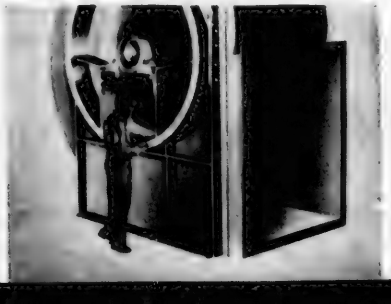
. . . there's a TRANE Fan for every job!

Axial roof ventilator provides economical ventilation for mills, factories, warehouses. Designed with lower silhouette, costs less to install and operate. 5 sizes. Models also for handling corrosive and explosive fumes and gases. Centrifugal roof ventilators also available.



TRANE Industrial fans are available in 3 basic wheel types: A, for exhaust systems; B, for granule-conveying; S, for stringy material. 11 sizes, 11" to 37" inlet diameter; 5 arrangements to meet any process system need.

Class III fans are designed for high-pressure air conditioning systems, industrial processing and drying. 15 standard sizes from 18" to 73", for static pressures up to 11½". Complete line of Class I and II fans also available.



Packaged utility fans are designed for supply and exhaust in hundreds of ventilation applications. Advanced design features assure exceptionally smooth and quiet operation, long life. Available in capacities to 15,450 cfm.

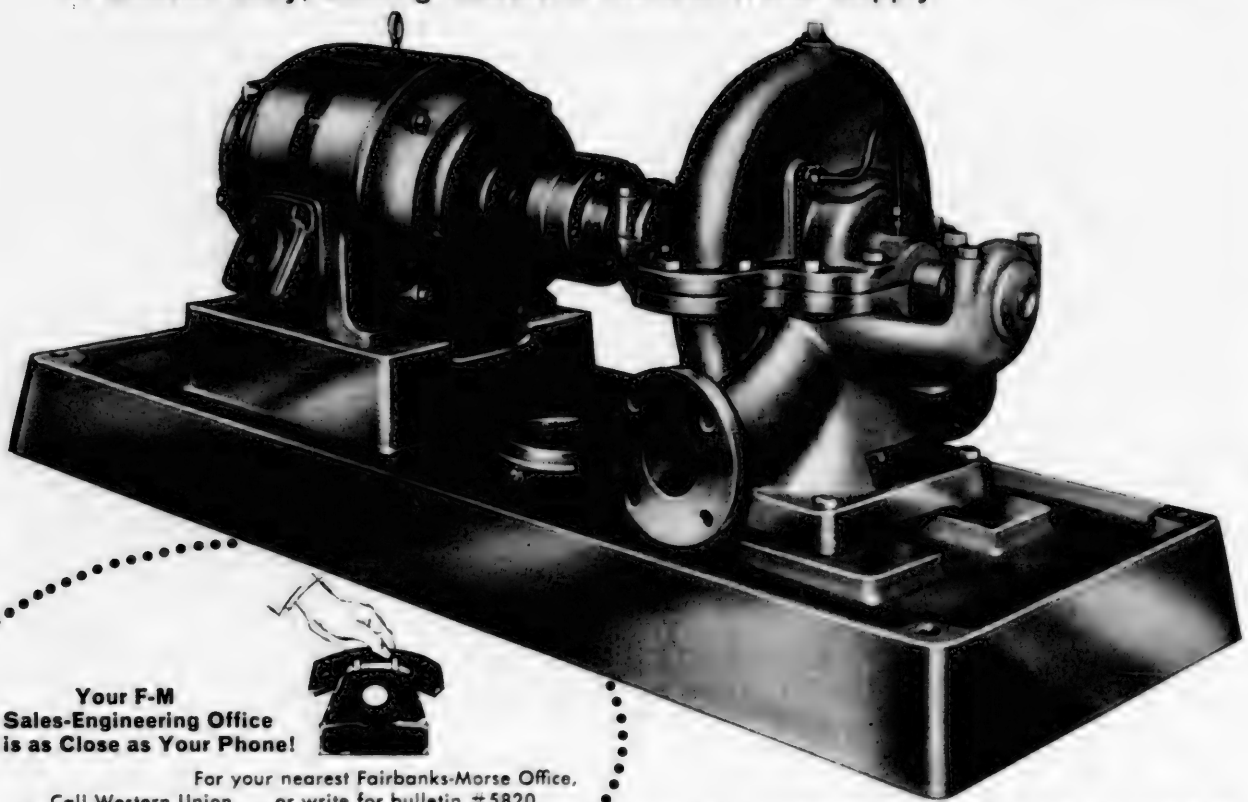
Fairbanks-Morse Announces!

A NEW SPLIT-CASE PUMP

FOR THE AIR CONDITIONING INDUSTRY

specifically designed for **MODERATE COST INSTALLATIONS**

Single Stage, Horizontal Split-Case Centrifugal Pump for Chilled Water, Circulating or Booster Duty; Cooling Towers or General Water Supply.



Your F-M Sales-Engineering Office is as Close as Your Phone!

For your nearest Fairbanks-Morse Office, Call Western Union . . . or write for bulletin #5820, Fairbanks, Morse & Co., Pump and Hydraulic Division, Kansas City, Kansas

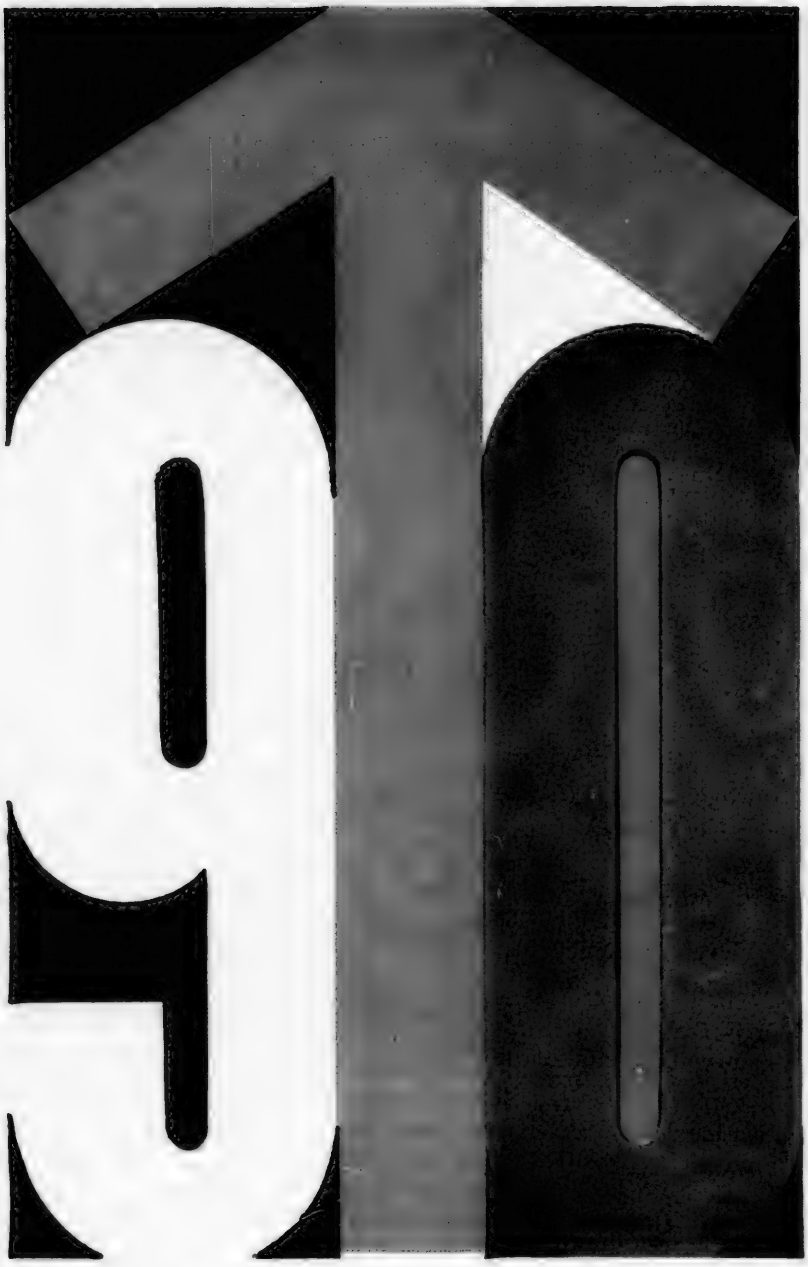
NOTE THESE DESIGN FEATURES!

- Replaceable casing wearing rings . . . for increased pump service life
- Mechanical shaft seals (or packing box)
- Sealed prelubricated bearings requiring no lubricating service
- Heavy cast-iron base, drip-lip design

Fairbanks, Morse

Pump and Hydraulic Division

A MAJOR INDUSTRIAL COMPONENT OF **FAIRBANKS WHITNEY CORPORATION**



New Airfoil Bladed Fans exceed 90% efficiency

It's here now—a new line of Airfoil Bladed Fans from American-Standard Industrial Division . . . all carrying the AMCA certified rating seal! A completely new design, these Airfoil Bladed Fans employ a highly efficient, quiet fan configuration ideally suited for general ventilation and industrial process applications. High mechanical efficiency, over the entire fan selection range, means the lowest possible power requirements. Get the complete story. Send for Bulletin A-1103 today. American-Standard Industrial Division, Detroit 32, Michigan. In Canada: American-Standard Products (Canada) Ltd., Toronto, Ontario.

American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation

AMERICAN-Standard
INDUSTRIAL DIVISION

AMERICAN BLOWER PRODUCTS • ROSS PRODUCTS • KEWANEE PRODUCTS

Now—a new appearance concept for low-budget commercial installations

The "Power-Plant" Look

with Johns-Manville FIBROCEL Insulation!

Now you can bring the traditionally fine appearance and performance excellence of your power plant work to general commercial and industrial installations... with Johns-Manville Fibrocel® Insulation!

Why these power plant advantages? Simply because Fibrocel is molded! The only commercial insulation made (by a precision metal mold) to near-perfect roundness, with unmatched uniformity of size and line.

This means an immediate end to costly finishing, heavy jacketing, needless pointing up of cracks and apertures. Instead, Fibrocel gives you a tighter, better looking installation just as it is applied. Pipelines are gun-barrel straight, firm end to end. The look of a power plant!

Fibrocel's dimensional uniformity again pays off in fuel savings—pipe is always "dead center," with lengths butted tight to provide maximum insulating effectiveness.

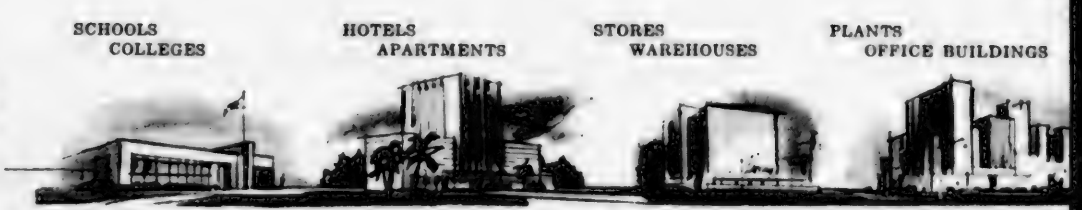
Let us send you the informative new brochure, IN-155A. It gives you full details on Fibrocel's thermal performance. Illustrations show why Fibrocel installs easier . . . takes abuse, too. Keeps its fine appearance and performance excellence for the life of the installation. Write for it today!

Address Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

JOHNS-MANVILLE

...Specify Fibrocel for the "POWER PLANT" look in installations like these (35F to 300F)



HOSPITALS
INSTITUTIONS

one p-k scalefree 230* used for—

1 - supplying all domestic hot water
2 - for baseboard radiant heating
3 - for reheat in air conditioning system

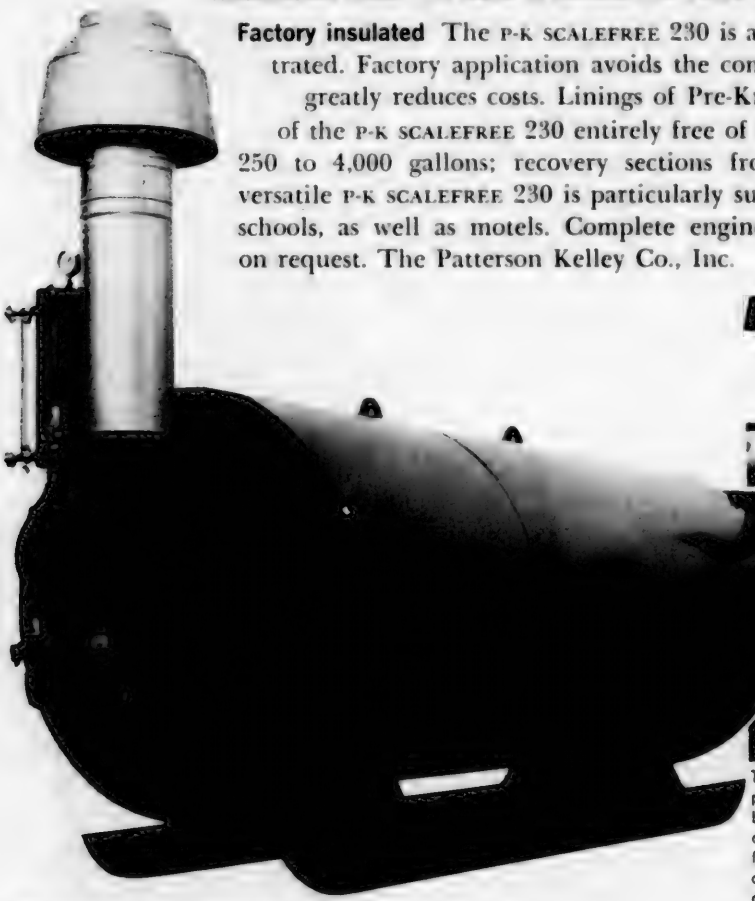
To supply all the hot water required for domestic service, baseboard heating, and reheat in air conditioning system, owners of the handsome Carousel Motel and Restaurant selected the new P-K SCALEFREE 230 . . . the industry's first indirect gas fired storage water heater. » » » High among reasons for choosing the P-K SCALEFREE 230 — It won't scale, and retains its rated efficiency, because heat transfer occurs below the temperature at which scaling minerals precipitate.

Quickly installed A complete and automatic package, the P-K SCALEFREE 230 can be skidded into place, hooked up and checked out quickly. There is no complicated piping or electrical work to run up installation costs. No stack is needed for extra draft. No foundation is necessary.

Factory insulated The P-K SCALEFREE 230 is available with factory insulation as illustrated. Factory application avoids the complications of on-the-site insulating and greatly reduces costs. Linings of Pre-Krete® or copper keep the storage section of the P-K SCALEFREE 230 entirely free of corrosion. Storage capacities range from 250 to 4,000 gallons; recovery sections from 390,000 to 2,215,000 B.T.U. The versatile P-K SCALEFREE 230 is particularly suited to office buildings, institutions and schools, as well as motels. Complete engineering and performance data available on request. The Patterson Kelley Co., Inc.

Patterson Kelley

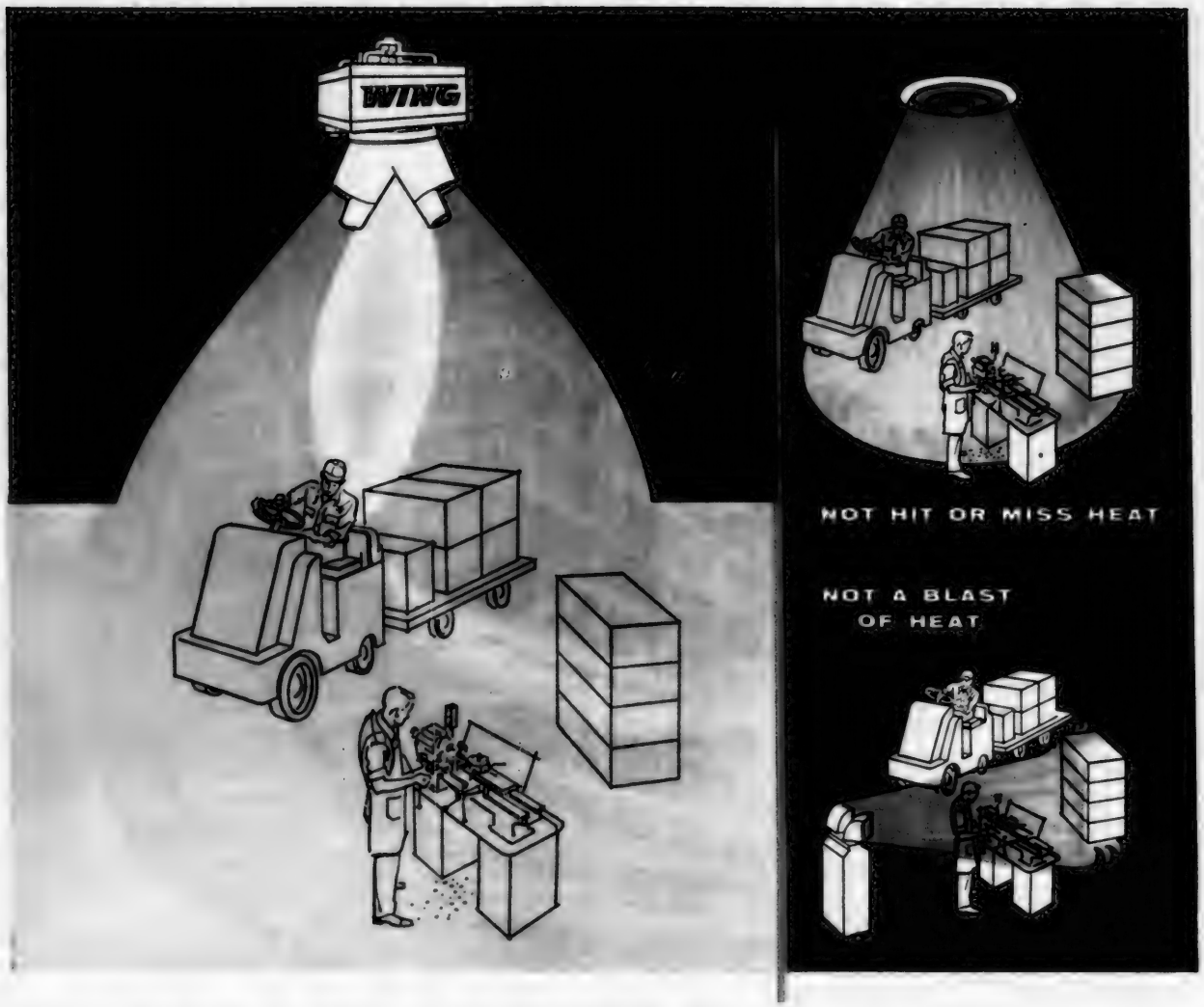
Water Heater Division
101 Morgan Avenue, East Stroudsburg, Pa.



Heating-Air Conditioning Contractor, Kingston Electric Co., Kingston, Pa.

The Carousel Motel and Restaurant, with a capacity of 600 persons, recently opened at Wilkes-Barre, Pa., is owned by William Heck, William Heck, Jr., and Thomas Heck. They chose the P-K SCALEFREE 230 because it offered ideal performance and economy features for a service business such as theirs. The Pre-Krete lined unit has a storage capacity of 500 gallons, and a recovery rate of 325 gallons per hour from 40°F to 140°F.

*Patent pending



Only Wing Revolving Heaters Provide a Sweeping Flow of Perfect Heat

The unique slowly revolving discharge of Wing Heaters blankets the heating area—and does it more economically—than other heating units. With Wing Heaters, you can be sure that warm air is spread over the entire working area—throughout the occupancy zone, behind and around obstructions and into corners. There are no cold areas or torrid blasts as with other heater designs. Result? Workers are more comfortable and more productive.

Wing Revolving Units provide greater coverage—fewer units are needed—so, installation savings result. Standard units can be mounted from 8 to 65 feet. Higher mountings can be met if desired.

Wing Revolving Heaters have proved their outstanding performance in thousands of installations over many years of service life. They are easy to install, simple to maintain—and are available for steam, hot water or gas. Four types of revolving discharges are available to suit your requirements.

Write today for complete information telling how Wing Revolving Heaters can give you lowered costs and reliable operation.

L. J. WING MFG. CO.
DIVISION OF AERO SUPPLY MFG. CO., INC.
153 VREELAND MILLS ROAD, LINDEN, NEW JERSEY
FACTORIES: LINDEN, N. J. AND MONTREAL, CANADA
IN EUROPE: WANDON, HAEN-NORD, BRUSSELS, BELGIUM

WING

Architect: William B. Tabler, New York. *General Contractor:* Daniel Construction Co., Jacksonville. *Consulting Engineer:* Slocum & Fuller, New York. *Mechanical Contractor:* Henley & Beckwith, Jacksonville. *Interior Decoration:* Walter M. Ballard Corp., New York.

Keeps conventioneers cool and comfortable with GAS and CARRIER absorption refrigeration

The ultramodern new Robert Meyer, Florida's newest and largest commercial-convention hotel, leaves nothing undone for the maximum comfort of its guests. For year 'round climate control they chose one of the most efficient, up-to-date systems available ... Carrier Weathermaster* air conditioning and absorption refrigeration energized by steam from a gas-fired boiler.

The Carrier absorption system is the essence of simplicity and economy. It quietly and efficiently converts steam or hot water from a gas-fired boiler into chilled water for air conditioning. Thus, boiler capacity is put to use on a year 'round basis ... cooling in summer, heating in winter. And thrifty gas keeps fuel costs low.

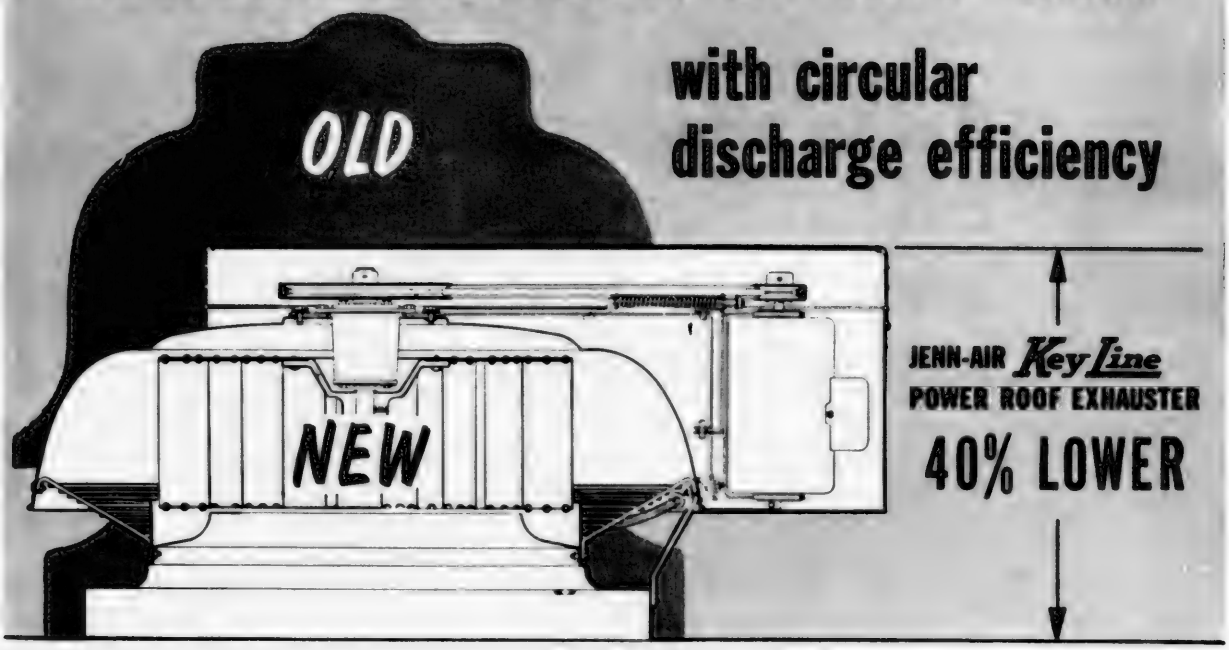
For highest efficiency in year 'round air conditioning, specify Gas and Carrier Absorption Refrigeration. Performance data and cost details are yours for the asking. Call your local Gas Company, or write Carrier Corporation, Syracuse 1, New York.
American Gas Association.

FOR HEATING & COOLING GAS IS GOOD BUSINESS!

This 750-ton capacity Carrier absorption unit, one of the largest of its type in the South, supplies chilled water to carry the full load for year 'round air conditioning at the Hotel Robert Meyer.

LOWEST CONTOUR OF ANY UNIT

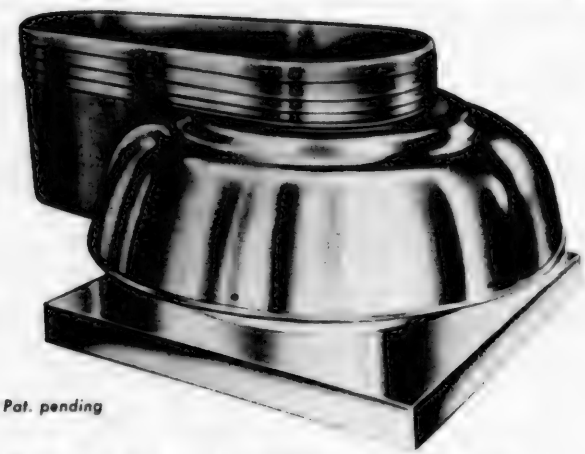
with circular discharge efficiency



...and motor and drive are out of air stream!

Check these other KEY features:

- Maintenance-free spun aluminum housing
- Ten-year-lubricated ball bearing motor mounted out of air stream
- Drive with permanently sealed and lubricated ball bearings
- Heavy cast iron pulleys, adjustable to permit speed variation
- Belts with long drive centers for extra-long wear
- Automatic belt tightening device to assure constant fan speed . . . no service call-backs for adjustment
- Built-in bird guard
- Hinged curb for damper access (optional)



Pat. pending

The Jenn-Air KEY LINE meets the most critical standards for styling, quiet operation and air moving efficiency . . . it's the key to better ventilation in any roof installation. Centrifugal or axial models. Capacities from 725 to 27,000 cfm. Write for Bulletins 60-CK (centrifugal) and 60-AK (axial).

JENN-AIR

JENN-AIR PRODUCTS COMPANY, INC. • 1102 Stadium Drive • Indianapolis 7, Ind.

JENKINS PRACTICAL PIPING LAYOUT

83

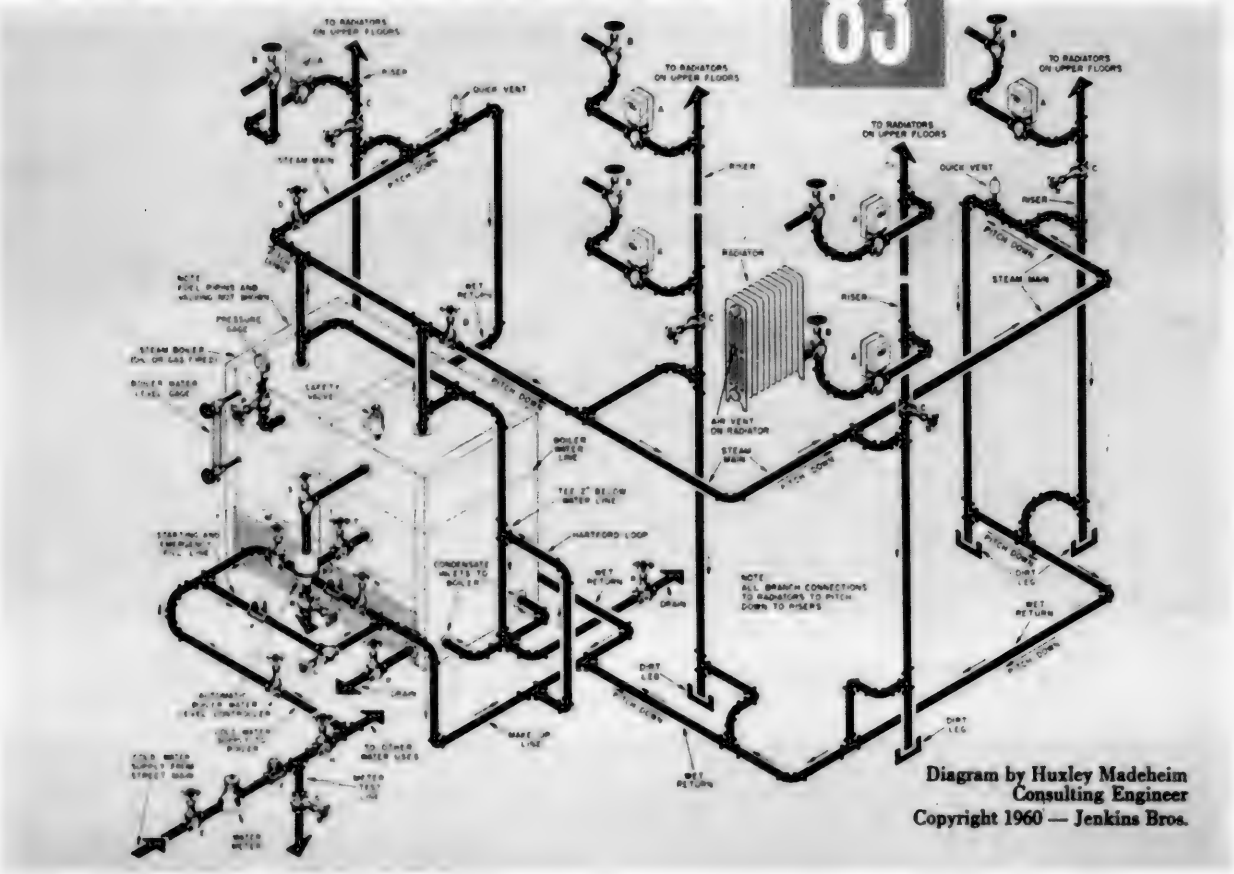


Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1960 — Jenkins Bros.

ONE-PIPE HEATING SYSTEM WITH INDIVIDUAL THERMOSTATIC CONTROL OF EACH AREA

Because of low installation, operation and maintenance costs, this one-pipe system is popular for multi-story buildings where radiators are placed one above the other in line on various floors. It requires no traps, pumps, expansion or balance tanks or special fittings, and its simplicity avoids danger of freeze-up or water leaks. Thermostatic control of the fuel burner and elimination of dependence upon manually-controlled radiators remove principal objections to the conventional one-pipe system . . . the time delay in starting from a cold boiler, uneven heating due to this delay, and insufficient pressure to assure steam in furthermost radiators.

The burner in the boiler of this system operates responsive to an outdoor thermostat which starts or cuts off the burner whenever outside temperature changes from a predetermined value. The burner is also controlled by a pressurestat which cuts off burner at a predetermined value such as 8 psi, and starts it at a lower limit such as 4 psi. The burner can also be controlled by a program clock.

Each individual radiator or area is controlled by a motor operated globe valve of the type made by New England Gear Works, Southington, Connecticut. Each of the valves opens or closes responsive to a thermostat located in the area served by the radiator. The combination of outdoor and area thermostats assures steam in the system and even heat at all times in all areas. A manually-operated radiator angle valve permits shut-off of each radiator whenever desired. A gate valve at bottom of each riser allows access to motor operated valves on that line.

Conventional steam boiler piping and controls are used, with an automatic boiler water level controller, fitted with a manually operated by-pass.

Jenkins Fig. 47-U Standard Bronze Gate Valve, in this layout has design features which assure excellent performance in steam heating service. A solid bronze wedge affords maximum resistance to pressure strains of rapidly vibrating steam. A rising spindle and wheel indicates wedge position, and the backseating bevel on shoulder of spindle permits the valve to be repacked under pressure when wide open.

To assure efficiency in the job when planning any major piping installation, consult with accredited piping engineers and contractors, and select your valves from the Jenkins Catalog.

Enlarged diagram and full description of this layout No. 83 free on request to Jenkins Bros., 100 Park Avenue, New York 17.

CODE	QUAN.	VALVES RECOMMENDED	SERVICE
A	8	Motor Operated Globe made by New England Gear Works	Automatic Steam Control
B	8*	Fig. 168, Bronze Radiator Angle	Manual Control Steam to Radiators
C	4**	Fig. 47 U, Bronze Gate	Individual Riser Shutoff
D	2	Fig. 47 U, Bronze Gate	Boiler Mains Shutoff
E	1	Fig. 47 U, Bronze Gate	City Water Supply Shutoff
F	1	Fig. 92 A, Bronze Swing Check	Prevent Backflow into City Water Main
G	1	Fig. 106 A, Bronze Globe	Motor Test Flow Control
H	1	Fig. 47 U, Bronze Gate	Building from Motor Shutoff
J	1	Fig. 47 U, Bronze Gate	City Water Make-up to Boiler Shutoff
K	2	Fig. 92 A, Bronze Check	Prevent Backflow from Boiler to City Water
L	1	Fig. 108 A, Bronze Angle	Manual Control Water to Boiler
M	1	Fig. 106 A, Bronze Globe	Control Automatic Boiler Water Level Controller
N	1	Fig. 47-U, Bronze Gate	Shutoff Automatic Boiler Water Level Controller
P	1	Fig. 743 O, Bronze Needle	Steam to Pressure Gage Control
R	3	Fig. 108 A, Bronze Angle	Control Drainage from Boiler and Equipment
S	1	Fig. 108 A, Bronze Angle	Shutoff Automatic Boiler Water Level Controller from Boiler
T	1	Fig. 106 A, Bronze Globe	Shutoff Automatic Boiler Water Level Controller from Boiler

*One for each Radiator **One for each Riser

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864
Jenkins Bros

Sold Through Leading Distributors Everywhere

New rink in Tonawanda

built with Ammonoduct Steel Pipe

It's the new 85 by 185 ft Brighton Park Arena, Town of Tonawanda, N. Y., built by *Mollenberg-Betz Machine Company, Inc.* Park and Recreation Consultants: *Tryon & Schwartz & Associates.* Consulting Engineer: *William E. Harries.* The 58 tons of Bethlehem 1¼-in. standard black plain end Ammonoduct steel refrigeration pipe was supplied through *Commercial Pipe and Supply Company.*

Steel *for Strength ... Economy ... Versatility*

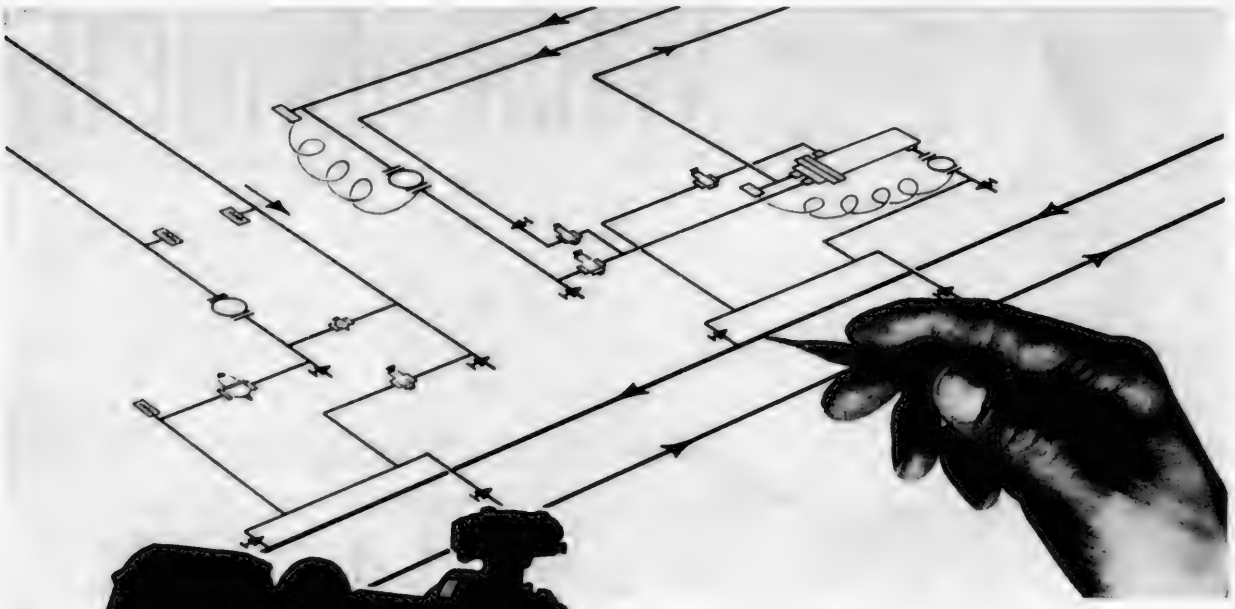
Piping a new ice rink with steel is an easy way to please everyone. Owners find it economical—steel pipe costs considerably less than any other ferrous piping material. Contractors save on installation costs—in double-random lengths, Ammonoduct steel pipe eliminates many field welds; and it can be fabricated *cold* without fracture. Well-designed rinks piped in steel give long, trouble-free service—a boon to rink management.

Make your next rink a pleasure all around—underline it with Ammonoduct steel pipe. Your pipe distributor can give you the complete story. Or call the Bethlehem sales office nearest you.

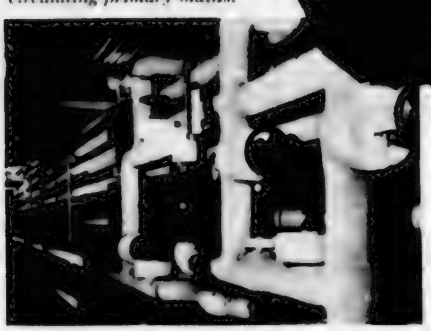
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA
Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



B&G Universal Pumps circulating primary mains.



B&G Booster Pumps supplying individual heating zones.

Primary and secondary pumping as developed by B&G® cuts heating system operating costs

Where multiple buildings or multiple zones within a building are to be heated with circulated water, *Primary and Secondary Pumping*, as conceived and developed by Bell & Gossett engineers, both reduces pump horsepower and saves fuel by improving heat control.

A typical system consists of a primary main continuously circulated by a B&G Universal Pump, with smaller B&G Booster Pumps drawing on the main to supply separate heating zones. Each zone pump is under individual thermostat control, so that each zone can be supplied with exactly the amount of heat required by its function or exposure.

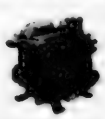
Write for free booklet which gives detailed information on this more efficient, more economical method of heating with circulated water.

BELL & GOSSETT
COMPANY
Dept. GJ-4, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

A DIVERSIFIED LINE OF HIGHEST QUALITY PRODUCTS

Booster Pumps

Package Liquid Coolers



Refrigeration Compressors

Marlow Pumps

Heat Exchangers

Oil-less Air Compressors

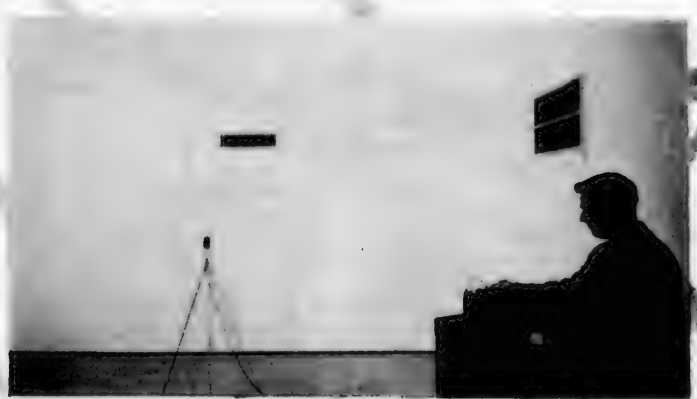
What about the
Noise criteria curves demonstrate permissible sound levels
Accurate performance data assures you of the best possible auditory environment
Ask to hear it: new Barber-Colman slide film "Making Sound Behave"

auditory environment?

Facts about air distribution sound levels of importance to engineers and architects

An architect skillfully uses both color and light to create the proper environment. A good analogy exists between an architect working with frequencies of light (color) and an engineer creating ideal air distribution specifications with sound.

Until recently engineers used only the decibel level in selecting air distribution equipment. Today this is not



enough to assure comfortable environment, for sound must be measured and specified not only in terms of over-all magnitude, but also in magnitude at different frequency levels.

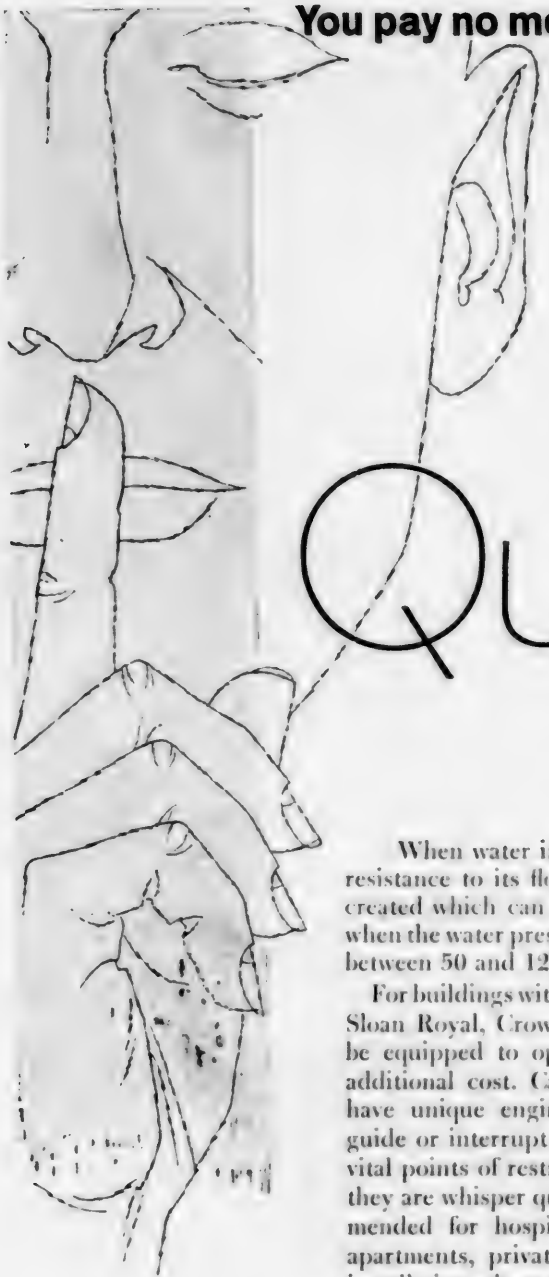
To help you create the proper auditory environment, Barber-Colman has built modern sound laboratories where engineers break down into eight octave bands the sound of air passing through Uni-Flo diffusers. The decibel value of each band then is charted for a complete range of capacities.

The results are twofold: data is available for comparison with noise criteria curves which are used for specifying permissible sound levels in different frequency bands; scientifically proved performance data is provided for correct selection of air distribution equipment.

Ask for literature and be sure to see — and hear — Barber-Colman's new slide film, "Making Sound Behave."

BARBER-COLMAN COMPANY
Dept. H, 1102 Rock Street, Rockford, Illinois

You pay no more for unequalled SLOAN quality...



Quiet

When water in a plumbing system meets a resistance to its flow, audible sounds are often created which can be objectionable—especially when the water pressure is excessive (in the range between 50 and 125 P.S.I.).

For buildings with water pressure in this range, Sloan Royal, Crown or Naval Flush Valves can be equipped to operate quietly at only slight additional cost. Called *Quiet-Flush* Valves, they have unique engineering features added that guide or interrupt high velocity streams at two vital points of restriction to quiet the flow. Yes, they are whisper quiet and are especially recommended for hospitals, hotels, motels, homes, apartments, private office toilet rooms or any installation where quietness is essential.

Quiet-Flush is another product of Sloan research which is constantly employed to help sustain Sloan's outstanding leadership of more than fifty years. And, since Sloan Flush Valves today are better than ever, why not make sure you get them?

SLOAN FLUSH VALVES

SLOAN VALVE COMPANY • 4300 WEST LAKE STREET • CHICAGO 24, ILLINOIS

Ever hear of a bashful air-cooled condenser?

Check the new Halstead & Mitchell vertical air flow condenser

H&M's new ACV Air-Cooled Condenser with vertical air flow hates to be showy. It's so low and so quiet, you hardly know it's there—very appealing to owners, their neighbors, architects and engineers!

Roof loading is low, too, and air flow noise is directed away from surrounding structures. This delights building owners and tenants alike.

Vertical air flow models are available in 5 to 100 tons. And like all H&M Air-Cooled Condensers, the ACV series features exclusive Turbu-Flo fins, spaced wide to prevent clogging by air-borne dirt. Multiple circuiting is available for your specific needs *at no extra cost.*

Get the whole story on H&M Air-Cooled Condensers—with propeller or centrifugal fan. Ask your refrigeration wholesaler for a copy of the new bulletin AC-102. Or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

ACV SERIES—
5 TO 100 TONS

HM

Halstead & Mitchell

Air-Cooled Condensers • Finned Coil Products • Water-Cooled Condensers • Cooling Towers

Gives You MORE, Costs You LESS Check all the FEATURES!*

RP

Listed

Multi-Velocity INDUSTRIAL AIR FILTER

FOR HEATING OR AIR CONDITIONING

✶ **ALUMINUM** construction...rust-proof...corrosion-resistant. Eliminates need for expensive, heavy structural design in filter bank construction.

✶ **EASY TO HANDLE** Light-weight permits carrying, washing and installing of many more filters per hour.

✶ **EASY TO CLEAN** Lint and dirt are easily flushed off with water because of water soluble Super Filter Coat (the adhesive with the built-in detergent).

✶ **DEPTH LOADING** Designed to minimize surface loading, with depth loading accomplished through successive layers of slit and expanded aluminum, and varying baffle sizes.

✶ **REMOVES ODORS** Revolutionary R P Super Filter Coat adhesive adds odor removal to the normal dirt-trapping properties of R P Industrial Air Filters —with no increase in resistance—at *no* extra cost!

✶ **GERMICIDAL** Super Filter Coat adhesive contains Hexachlorophene, the well-known bacteria destroying agent.

✶ **LOWER RESISTANCE** Unique baffle design permits maximum air passage...more uniform dust collection within the filter depth.

✶ **HIGHER EFFICIENCY** Scientifically staggered pattern of flat baffles sets up a controlled turbulence that centrifuges dust and odor particles onto the adhesive for maximum efficiency.

for information, write RP / *Products of Research*

RESEARCH PRODUCTS *Corporation* Dept. 47-J, Madison 1, Wisconsin

This mark tells you a product is made of modern, dependable Steel.

"We've been buying from National Tube Distributors for almost 25 years—and they've never let us down."

So says Mr. Stanley Carter, President, Stanley-Carter Company, Mechanical Contractors, Detroit, Michigan. *"Good distributor service is tremendously important to our profit margin. That's why we've been working with National Tube Distributors as long as we have.*

"We've never had a single project held up because of a late delivery from a National Tube Distributor—men and equipment tie-ups because of late shipments can waste a lot of money."

"We kept a big job right on schedule in Nashville, Tennessee, when the USS National Pipe arrived exactly at the time they promised it.

"It looked like we were headed for trouble on a big Detroit job this year. We needed a lot of pipe in a hurry. All it took was a few phone calls. We received the pipe within 24 hours."

"National Tube salesmen and distributors back us with technical assistance. They not only keep us abreast of changes in specifications but offer recommendations if specifications need to be changed."

"On this job, the distributor worked with the architect when a spec change was needed—the new specification was just as good for this particular job, and it saved us serious delays.

"A National Tube salesman helped recommend a specification equal to the original spec but for a less expensive material on a plant expansion job we were doing. Cut the cost about 10%."

"Another thing we like. These National Tube Distributors carry a complete stock of pipe sizes.

"And the quality is excellent. In the past 20 years, we've had no trouble with USS National Pipe. If trouble were encountered, we know help is as close as our telephone. We can call our National Pipe Distributor or National Tube, and the team goes into action immediately."

USS and NATIONAL are registered trademarks

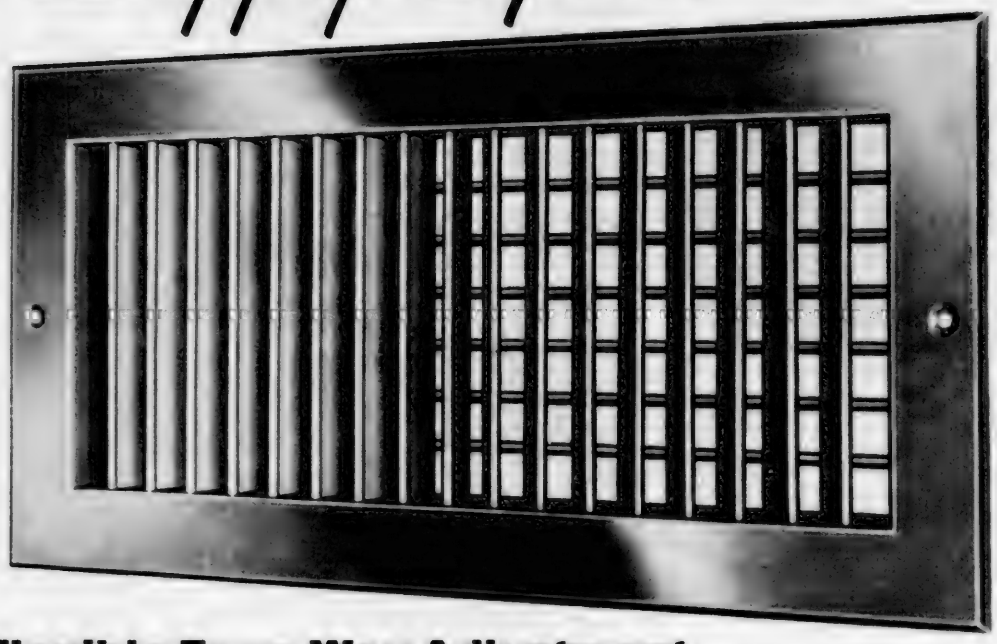
National Tube Division of United States Steel

Columbia-Geneva Steel Division, San Francisco Pacific Coast Distributors
United States Steel Export Company, New York

WATERLOO

Supply Grilles

MODEL 2V



• Flexible Four-Way Adjustment
• Extruded Aluminum Louvers • Sturdy Construction

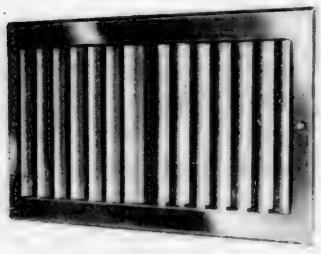
The two sets of adjustable louvers in Waterloo Model 2V *double deflection supply grilles* provide the flexibility needed to obtain four-way adjustment of the air stream. Solid section extruded aluminum louvers, pivoted with broad edge to the front, assure sturdy construction and enhance the room decor.

Waterloo also offers *single deflection supply grilles* which incorporate a single set of adjustable louvers for air flow in two directions. Popular Waterloo *supply registers* are available with opposed blade and multi-shutter dampers to meet varying service conditions. **• Write for the comprehensive catalog which gives complete data.**

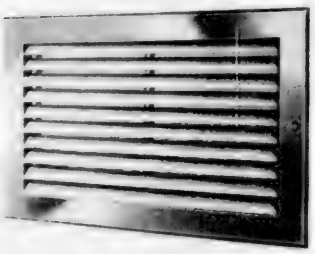
WATERLOO OFFERS A COMPLETE LINE

TYPICAL WATERLOO UNITS:

WATERLOO
CURVED LOUVER GRILLES
MODEL 1 CV2



WATERLOO
RETURN AIR GRILLES AND REGISTERS
MODEL 3HD

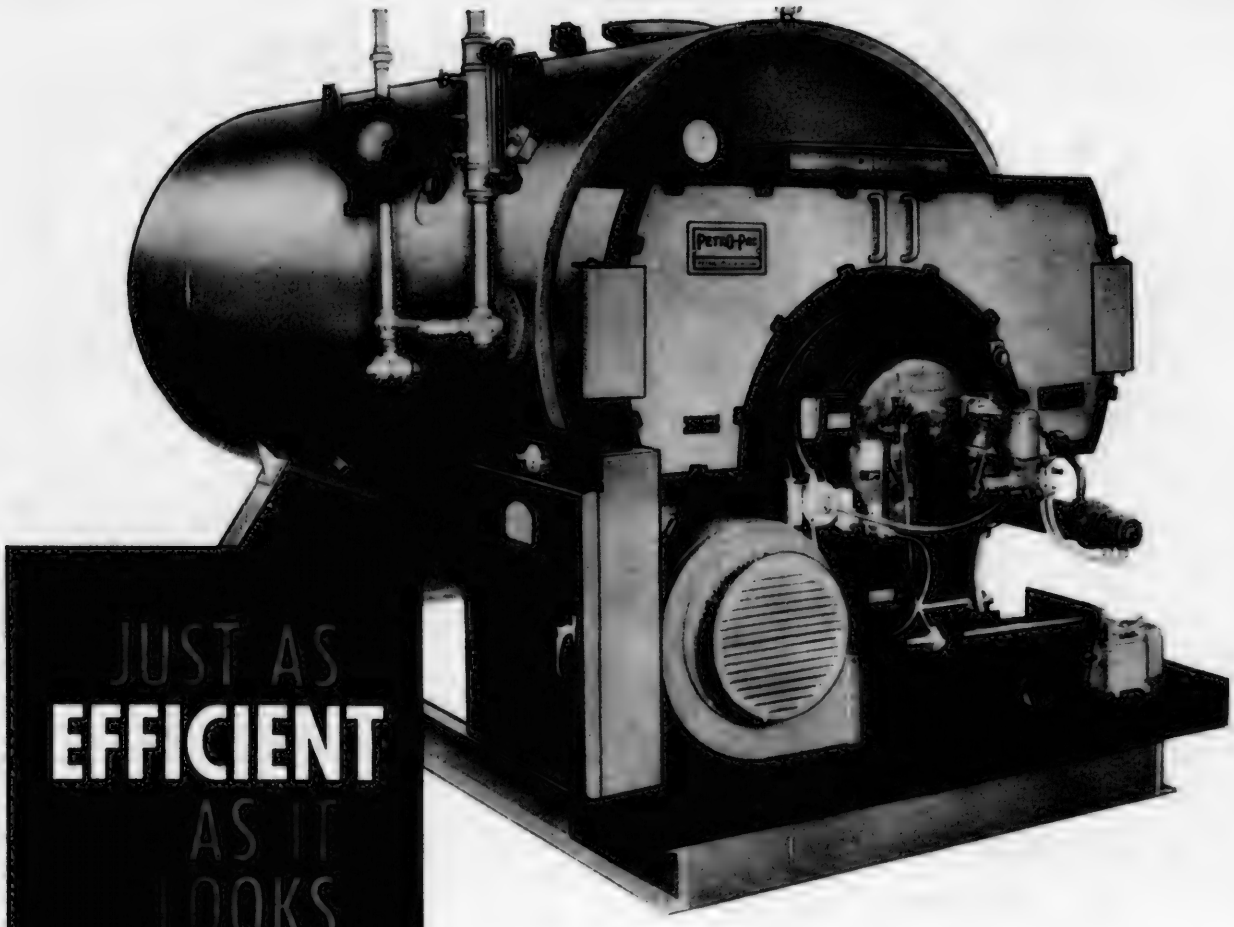


WATERLOO
AIRLINE GRILLES
MODEL AL1

WATERLOO
Air Diffusion
EQUIPMENT

WATERLOO REGISTER COMPANY, INC.
P.O. BOX 72, WATERLOO, IOWA

WR 116



JUST AS
EFFICIENT
AS IT
LOOKS

dependable PETRO units generate economical heat with oil or gas or both

FORCED DRAFT — low noise level, low power cost, no stack. Pressurized firing requires no chimney draft, simply an exhaust vent. The forced draft system (working in cool air instead of hot, expanded gases) takes much less fan capacity and only a fraction of the power required for induced draft firing, with consequent reduction in noise level.

Water cooled rear furnace. The rear furnace of the two-pass boiler is completely surrounded by the water jacket. Furnace heat is absorbed into the boiler water, not radiated into the boiler room. It also prevents leakage of flue gases and avoids the trouble and expense of refractory maintenance.

Quick reading control panel. Burner functions can be checked at a glance by means of visible gauges and signals along panel top, although the instruments are enclosed in a sealed cabinet to protect them against damage, dirt and moisture. All instrumentation and wiring are factory installed and factory tested.

Large furnace tube. The large volume furnace tube provides clean, efficient combustion automatically. This also provides an exceptionally large area of primary heating surface for the effective absorption of radiant heat. The large tube, combined with the "wet back" feature, (instead of heat reflecting refractory) keeps rear tube sheet cool for long boiler life.

Unobstructed flue doors. Gasket-sealed gas-tight flue doors can be easily opened without disturbing the burner mechanism. Doors are heavy gauge steel and are lined with insulation to reduce heat loss. Boiler tubes are readily accessible for inspection and service.

Dual or single fuel. Single fuel models available for either distillate or residual oils, or for any type of fuel gas. Dual fuel models cover the same fuel range, with instant change from one fuel to the other under manual or automatic control. Sizes range from 50 to 600 boiler horsepower for steam or hot water heating. Can be shipped as package, or boiler and burner shipped separately for field mounting.

Send coupon for full description and specifications.

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Makers of quality heating and power equipment since 1903

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Please send me literature and specifications on dependable PETRO steam and hot water generators.

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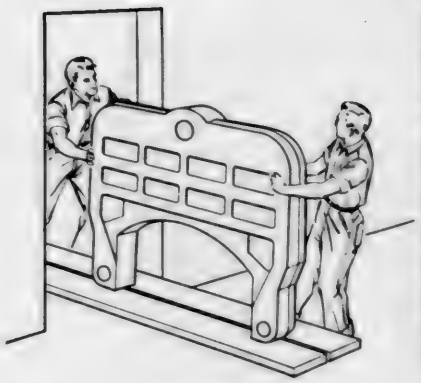


HOW TO PASS MILLIONS OF BTU THROUGH AN ORDINARY DOOR

You can do it easily with a Weil-McLain *sectional* cast iron boiler!

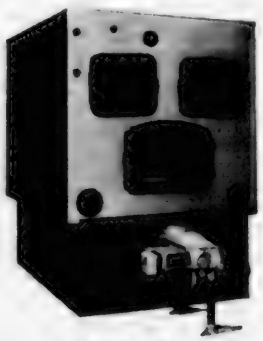
Any Weil-McLain boiler, no matter what its capacity, can be passed through an ordinary door, *section by section!*

In existing buildings, additional sections can be installed if extra capacity is needed (or an additional boiler), without structural changes. In new buildings, construction need not wait for boiler installation; the boiler can be installed after the job is under roof.

Sectional Weil-McLain boilers offer these additional *plus* values... less boiler room space needed... built of corrosion-resistant cast iron ...strain-free assembly with short draw rods...tested and rated by I=B=R...easy maintenance and long life.

Weil-McLain Cast Iron Sectional Boilers for commercial and industrial installations are available for gas, oil, heavy oil, combination gas—light oil or coal. For full information write Weil-McLain Company, Michigan City, Indiana, or see Engineers' Product File or Sweet's Architectural File for current oil boiler data.

FOR GAS...
Net ratings to
3,354,000 BTU/hr.



FOR OIL
Net ratings to
2,942,500 BTU/hr.

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CAST IRON BOILERS

WEIL-McLAIN COMPANY • Dept. BB-100 • MICHIGAN CITY, INDIANA

You're in luck when you look to ILG for unit heaters

Next time you need unit heaters, all you need do is look to Ilg. For *only* Ilg has everything you want . . . *all four types of heaters.*

Whether you prefer all-electric, gas-fired, steam or hot-water units, Ilg can meet your preference with a variety of sizes and types.

Ilg All-Electric Unit Heaters. Sizes from 1½ kw., 5118 BTU/hr. to 36 kw., 122,832 BTU/hr. Non-glowing, steel-sheathed, black-heat type with replaceable heating elements. Built-in thermal cutout protection against overheating. Quiet operating with Ilg type Q fan wheel.

Ilg Gas-Fired Unit Heaters. *Propeller type* is lightest, smallest on market. 10 sizes to 250,000 BTU/hr. Direct-connected. *Centrifugal type* moves large air volumes at low tip speed. 8 sizes to 250,000 BTU/hr. V-belt drive. Fully automatic controls.

Why shop around? Select all your unit heaters from a single source—Ilg. For further details on electric heaters, write for Bulletin 809; for gas-fired heaters, Bulletins 1501 and 286; for steam and hot-water, Bulletin 357.

ILG ELECTRIC VENTILATING CO.
2851 N. Pulaski Road
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Offices in 60 principal Cities
Member of Air Moving and Conditioning Association, Inc. (AMCA)

Ilg Steam and Hot-Water Unit Heaters. *Horizontal* models in 19 capacities. Aluminum fan blades. Copper tubes and aluminum fins. One-piece cast headers for 4-way pipe connection. *Vertical* models in 19 capacities. Type V for standard-outlet temperatures; VL for low-outlet temperatures.

Corrosion-resistant, fireproof vents

...with eye-appeal!

Vertical exposed flues of Transite Vent Pipe form eye-catching design on new Rockwell Manufacturing Co. installation

A GLANCE at this attractive new plant tells you that the material used for the exhaust flues is vital—vital to the plant's appearance . . . vital to maintenance economy.

That's why Walter Wagner & Partners, Architects & Engineers of Fresno, Calif., chose Transite Industrial Vent Pipe to exhaust corrosive fumes from the plant's small parts casting pots.

Made of asbestos-cement, Transite® retains its good appearance through years of weather. *Saves on upkeep*, because it never needs painting or preservative coating. *Saves on maintenance*, because it resists the attack of most gases, mists, fumes, and dusts. Installed indoors or out, Transite offers you these same appearance and maintenance-free advantages.

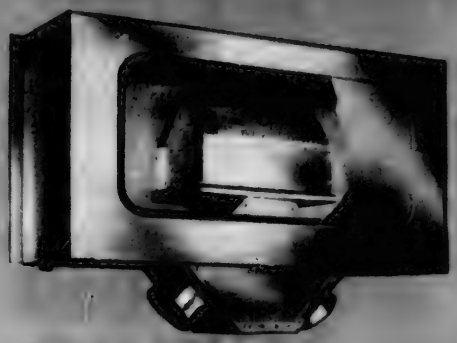
Transite also offers many layout and installation economies. A wide variety of fittings, diameters and lengths makes it readily adaptable to every venting service. Ease of cutting and handling add further to installation savings.

Let us send you DS-336—a 24-page brochure on Transite Industrial Vent Pipe. Write Johns-Manville, Box 14 HV New York 16, N. Y. In Canada, Port Credit, Ontario.

Architects & Engineers: Walter Wagner & Partners, Fresno, Calif. Mechanical Contractor: Robert Wright Plumbing, Porterville, Calif.

New plant at Porterville, Calif., has twenty-two 8" Transite exhaust flues. Joined by 14-gauge metal bands, each flue has clean, unbroken appearance.

JOHNS-MANVILLE JM PRODUCTS



DUAL-DUCT...

UNOBTRUSIVELY EFFICIENT

The mark of fine air conditioning is its unobtrusive efficiency. It cools in summer, warms in winter, always maintains proper conditions...and there are no visible ducts or room units. This description fits Dual-Duct to the letter. Air mixing units, built by the pioneer and leader in high velocity air conditioning, may be concealed overhead in the ceiling or below windows. Volume is readily adjusted upon installation, or, if preferred, it may be pre-set at the factory to your specifications. Either way, there is never a balancing problem with Buensod Dual-Duct thanks to exclusive Automatic Volume Control which maintains constant air volume regardless of variance in static pressures. So whether your next installation is for a new structure or a renovation, make it a Buensod Dual-Duct installation.

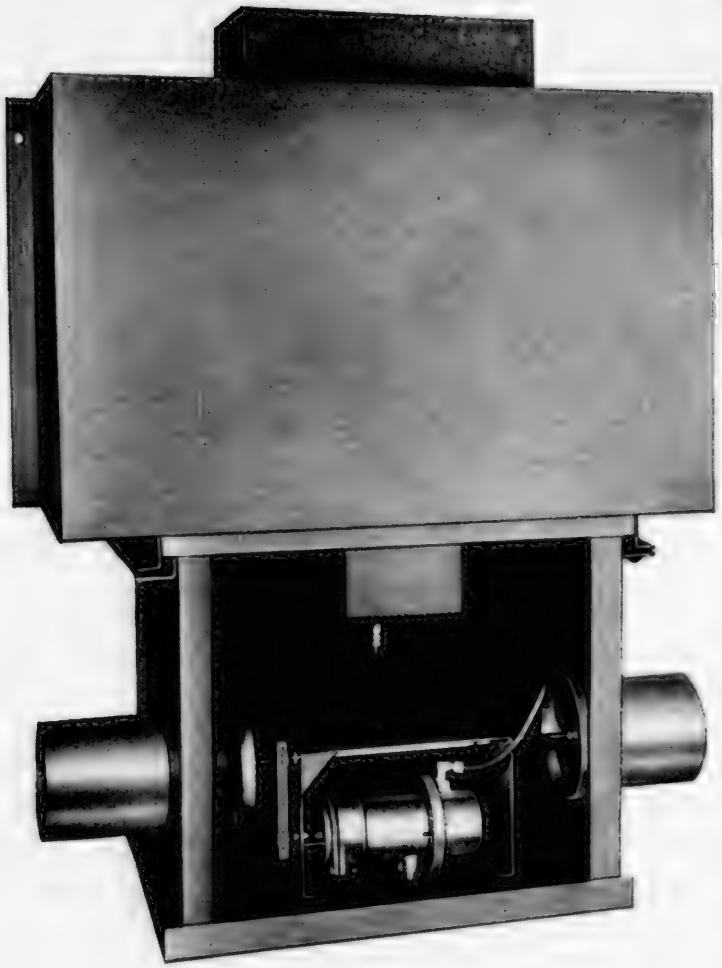
BUENSOD DUAL-DUCT

BUENSOD-STACEY CORP., 45 West 18th Street, New York 11, N. Y.

BUENSOD STACEY

A subsidiary of Aeronca Manufacturing Corporation

ALL NEW AGITAIR® MIXING BOXES



A MAJOR DEVELOPMENT IN CONSTANT CONTROL AND DISTRIBUTION OF HIGH VELOCITY TEMPERED AIR

A simple design of the all new AGITAIR Type "O" series, high velocity mixing boxes eliminates all troublesome linkages and pivots. Only one motor is employed to operate the inlet valves which are driven directly, guaranteeing instantaneous response with no lost motion or backlash.

The mixing valves proportion the hot and cold air in response to the room thermostat and the unique AGITROL volume regulator guarantees constant control of air delivery at the required volume.

Comprehensive noise attenuation tests were conducted to assure extremely low sound ratings for ceiling and under the window units. And for noiseless, draftless distribution of the conditioned air from these units, there is a complete line of AGITAIR diffusers and grilles from which to choose.

Technical catalog HV-100 contains complete performance data and dimensions on all AGITAIR units. Write for your copy today.

FEATURES

1. One motor — no linkages.
2. Aluminum inlet valves driven directly — instantaneous response . . . no lost motion . . . no backlash.
3. Unique AGITROL valve (constant volume regulator) actuated solely by the supply air.
4. Both mixing and attenuation chambers fabricated of galvanized or galvannealed steel . . . sealed to prevent air leakage.
5. Split fabrication of attenuation chamber permits dimension adaptation to meet most space limitations.

AIR DEVICES INC.
185 MADISON AVENUE • NEW YORK 16, N. Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

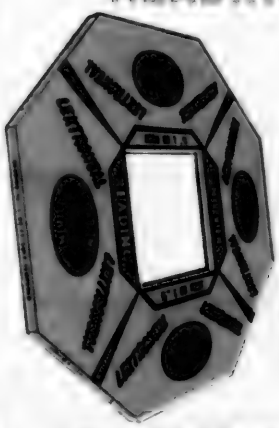
IN TUBING—Nothing Beats Copper!
IN COPPER—Nothing Beats
READING!

For

COPPER WATER TUBE

Specify

READING "LEKTRONEAL"®



Ideal in

- General Plumbing
- Heating Systems
- Drainage Waste and Vent Lines
- Sprinkler and Irrigation Systems
- Rural Installations

Features

- Soft Temper Tubes Can Be Curved Around Corners and Obstructions and thru Small Openings, yet Are Rigid Enough to Keep from Sagging without Support.
- Solder Fittings Can Be Applied More Quickly, Easily, Conveniently.
- Cuts Installation Costs Substantially as Compared with Other Materials.
- Enduring • Bright Clean Finish
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COPPER REFRIGERATION TUBE
Specify
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(In Varied Shapes)
RED BRASS & COPPER PIPE
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***Specify* READING**

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SMALL, SEAMLESS PRECISION COPPER TUBE
***Specify* MACKENZIE WALTON**
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* *Wholly Owned Subsidiaries*

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COMPLETELY INTEGRATED QUALITY CONTROL, FROM OUR OWN REFINERY TO OUR OWN DISTRIBUTION DEPOTS

HOW WOULD YOU LIKE

. . . to double the profit from new air conditioning business?

. . . to keep more service men busy in the winter so they are available to install more jobs in the summer?

. . . to make a substantial profit from your service business?

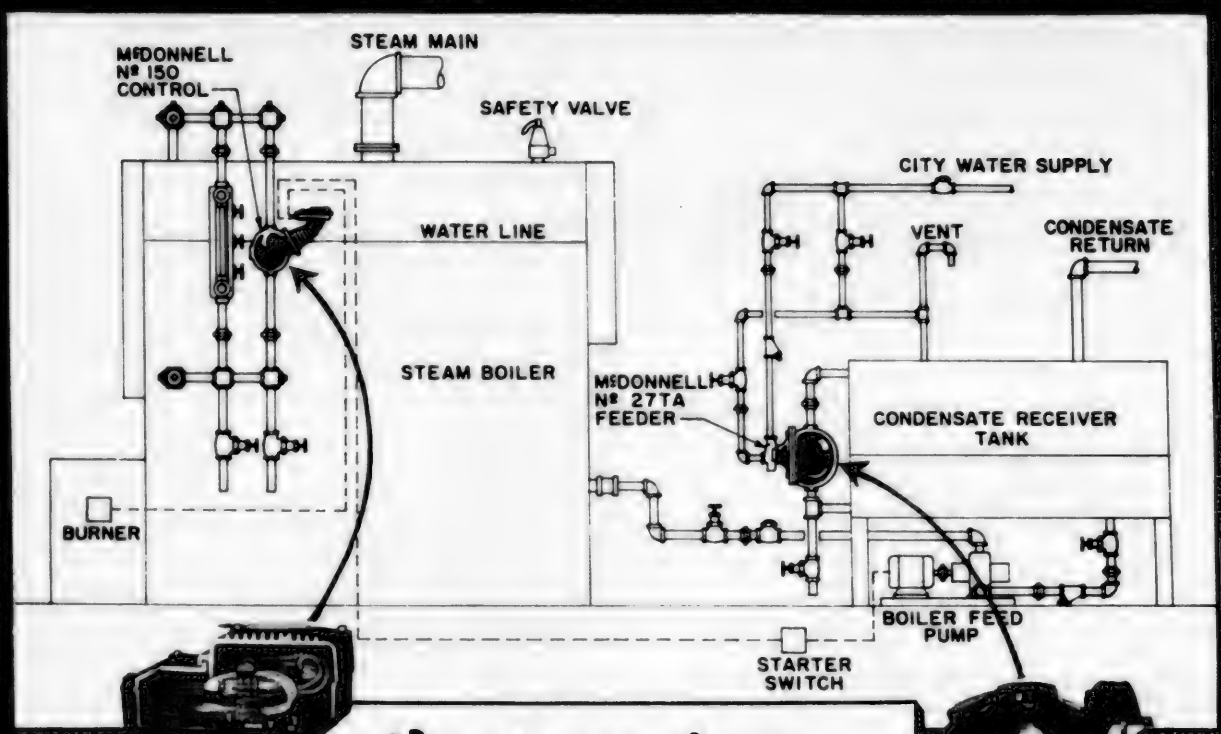
. . . to schedule your service work instead of having your customers schedule it for you?

Carrier dealers and only Carrier dealers have this opportunity with CPS—Carrier Planned Service. CPS is just one of many exclusives that make the Carrier franchise the most valued in the industry. Interested in details? Call the Carrier distributor listed in the Yellow Pages. Carrier Air Conditioning Company, Syracuse 1, New York.

Carrier Air Conditioning Company

A DIVISION OF CARRIER CORPORATION

The TWO BEST FRIENDS any boiler ever had



How to use them—

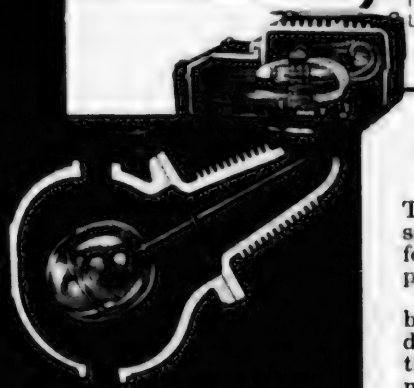
The drawing shows the simple hook-up that has solved the tough problem of water level control for medium pressure boilers... boilers with steam pressures up to 150 psi.

McDonnell No. 150 on the boiler controls the boiler feed pump as it should be controlled—directly *from* the boiler water level. This holds the water level within the close limits that assure maximum steaming efficiency and fuel economy.

McDonnell No. 27TA Water Feeder, installed on the receiver tank, adds the necessary make-up water as required by the system.

The low water cut-off and alarm in the No. 150 provides circuits for cutting off burner and sounding low water alarm—a final safeguard from emergency conditions such as current interruption in the pump circuit or failure of make-up water supply.

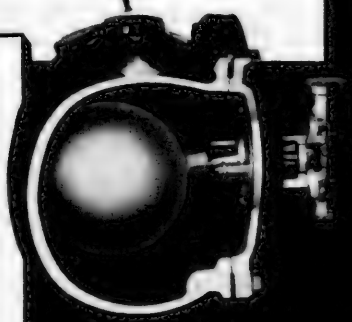
Yes, this is the most thoroughly proved, widely used hook-up of its kind, adaptable to every condition. McDonnell Water Level Controls are available for steam boilers up to 250 psi. and for hot water space heating boilers. *Write for information.*



THE PUMP CONTROL AND LOW WATER CUT-OFF:

McDONNELL No. 150

Used as pump control, low water fuel cut-off and low water alarm. Built in the McDonnell tradition to stand up under the temperatures and pressures such a control encounters. Underwriters' listed.



THE MAKE-UP WATER FEEDER:

McDONNELL No. 27TA

A float-operated make-up water feeder with the large feeding capacity and sturdy construction essential to maintain the required water level in receiving tanks. Other types for all needs.

McDONNELL & MILLER, Inc., 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

Your Jobber Stocks Them

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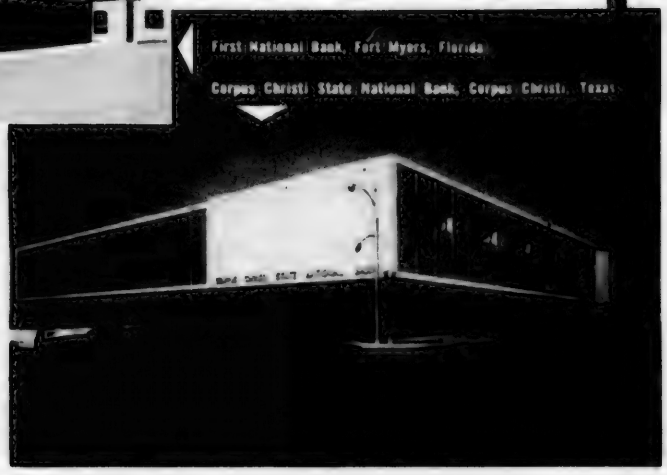
BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • FLOW SWITCHES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS

Thermal
Vertical Central
Plant



Satisfaction with THERMAL

that can't be discounted

Numerous Bank Buildings Depend on Thermal for Comfort

As the reputation for quality and dependability of Thermal air conditioning and ventilating equipment becomes known, more and more banks, as well as all other types of buildings, are using Thermal.

This is equipment with quality to give satisfaction and long life. Design features combine ready accessibility of internal components with rugged construction.

For further details on air conditioning and ventilating equipment you can specify with confidence, write for complete catalog and names of nationally known concerns using Thermal. The Thermal line includes central and multizone conditioners, sprayed coil units, heating and ventilating units, heating and cooling coils, and air-cooled condensers.

Here are some of the banks using Thermal equipment:

East Lake Branch of Birmingham Trust National Bank, Birmingham, Ala.
Commercial Bank, Andalusia, Ala.
Commercial National Bank, Daytona Beach, Fla.
First National Bank, Ft. Lauderdale, Fla.
Dade National Bank, Miami, Florida
Florida National Bank at Brent, Pensacola, Fla.
First Federal Savings & Loan Bldg., Hattiesburg, Miss.
East Central Branch, Bank of New Mexico, Albuquerque, New Mexico
Bank of Broken Arrow, Broken Arrow, Oklahoma
First National Bank, Muskogee, Oklahoma
First National Bank, Abilene, Texas
First Savings & Loan Bldg., Corpus Christi, Texas
Austin Savings & Loan Co., Austin, Texas
North Austin State Bank, Austin, Texas
Security State Bank, Beaumont, Texas
American National Bank, Beaumont, Texas
Farm-Home Savings & Loan Bldg., Ft. Worth, Texas
Raymondville State Bank, Raymondville, Texas
First National Bank, Rockport, Texas
Bellaire State Bank, Bellaire, Texas
Lockhart Savings & Loan Bldg., Lockhart, Texas
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Wherever protective plating is used on Jay R. Smith Products, you'll quickly notice that these parts are now plated with **"Gold Bright IRIDITE."** This new **Golden Touch** has been added to give these parts three times more effective and longer lasting protection against Rust and Corrosion.

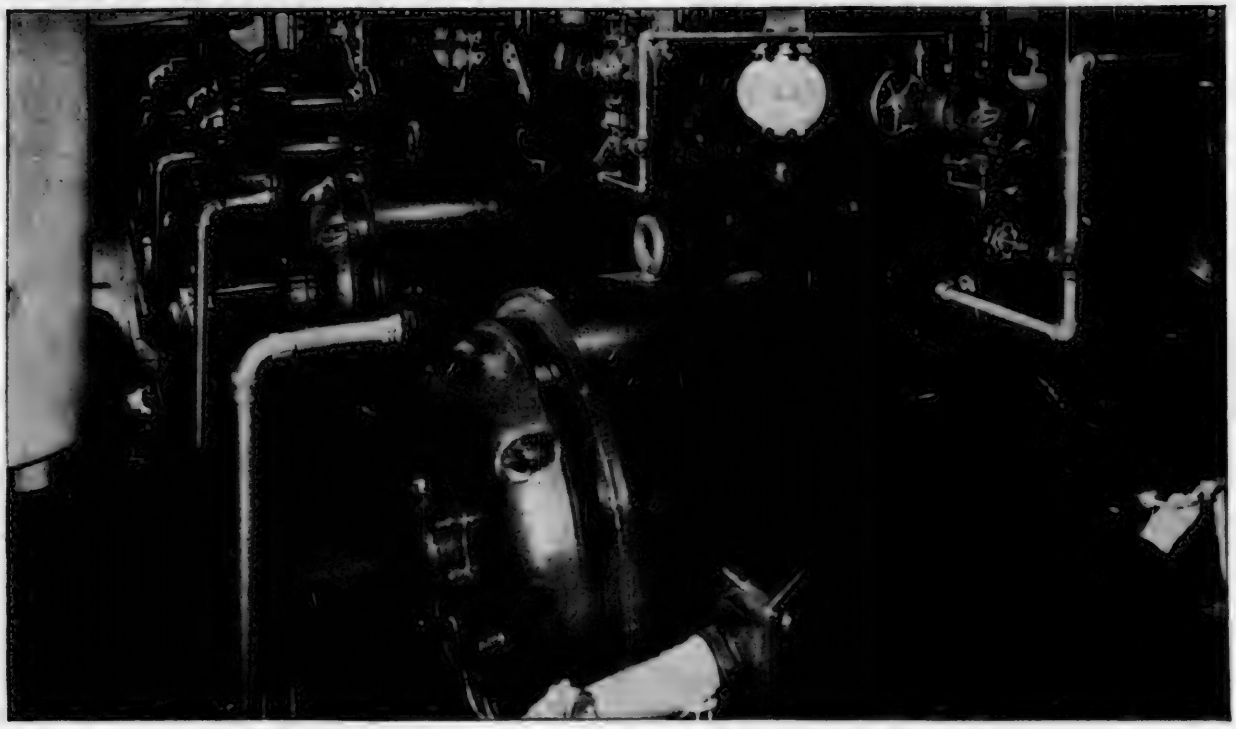
To provide this extra measure of protection, Smith now gives all these parts not one, . . . but two coats of protective plating. First each part is cadmium plated, and then completely replated with **Gold Bright IRIDITE.**

This process of double plating with both Cadmium and **IRIDITE** triples the life of Cadmium Plating in controlling and retarding the effects of galvanic action.

Gold Bright IRIDITE Protective Plating is but one more of the many extra features and refinements you always receive whenever you install or **SPECIFY . . . SMITH ENGINEERED PLUMBING PRODUCTS.**

CHAIR CARRIERS DRAINS INTERCEPTORS HYDROTROLS

WAGNER ELECTRIC MOTORS . . . THE CHOICE OF LEADERS IN INDUSTRY



End Voltage Drop and Line Disturbance Problems caused by starting BIG MOTORS . . .

Type RP polyphase motor in ratings to 500 hp with increment type starter.

Use Wagner Increment Motor-Starter Combinations

Increment starting is the easy, inexpensive way to limit the inrush of starting current in motors up to 500 horsepower. And, you do it *best* with Wagner Increment Motor-Starter Combinations . . . polyphase open-type, totally-enclosed, or explosion-proof motors and magnetic increment starters.

Line disturbances are reduced because current taken from the line is not broken during the starting period. Motors start sure and fast . . . reach full speed in a matter of seconds. And . . . Wagner combinations cost less than motors with primary resistance or auto-transformer type starters.

Two more plusses: The compact, relatively lightweight starter is easy to connect . . . needs very little attention. The motor requires only regular inspection, cleaning, and lubrication . . . maintenance is minimized.

While 2-step combinations are suitable for most applications . . . 3, 4, 5, or 6-step increment motor-starter combinations are available for installations where unusually low inrush of starting current is required. All meet the polyphase motor-starting requirements of AEIC-EEI-NEMA.

It's possible you can save money on your big jobs with Wagner Increment Motor-Starter Combinations. A Wagner Sales Engineer will help you. Call the nearest Wagner branch or write us for Bulletins MU-128 and MU-195.

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Wagner Electric Corporation

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ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

Design Comparison:

FLOOR DRAIN With Bucket*	WADE	BRAND "J"	BRAND "Z"
Weight	30 Lbs.	25 Lbs.	19 Lbs.
Type of Clamping Device	Wedge Type Clamping Units (Does Not Puncture Flashing)	Wedge Type Clamping Units (Does Not Puncture Flashing)	Bolted Type (Punctures Flashing)
Drainage Features	Triple Drainage	Triple Drainage	Double Drainage
Area of Seepage Flange	79.6 Sq. In.	69.17 Sq. In.	100 Sq. In.
Type of Weep Holes	Six Large (½" x ⅜" x 1") Trapezoidal Slots	Small Drilled Weep Holes	Small Drilled Weep Holes

*The basic floor drain with sediment bucket.

"...and strike out that 'or equal' ...Wade has no equal!"

NOTE: Drain comparison data based on manufacturers' published literature and on product samples purchased on the market.

WADE

WADE MANUFACTURING COMPANY
ELGIN, ILLINOIS

THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS

It's the Nash CSM

Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY

437 WILSON, SO. NORWALK, CONN.

Easily Drawn Graphs Show How Systems Will Work

Often it is a simple matter to plot a graph, enabling the designer quickly to visualize how his system will perform as conditions vary.

GORDON W. NEAL
Consoer, Townsend and Associates
Consulting Engineers, Chicago, Illinois

ENGINEERS responsible for design of piping, heating, ventilating, and similar systems are familiar with graphs for selecting individual equipment items. Manufacturers of valves, coils, pumps, and other system components find it convenient to provide graphical representations of equipment performance under different operating conditions.

On the other hand, system designers often hesitate to use graphs to analyze overall system problems. One reason for this is that these analyses often appear to be too complicated for practical applications. Further, since equipment graphs are subject to repetitive use, the time given to their preparation is readily justified. However, a graph of system performance is likely to be used only once, so that a great deal of time cannot usually be spent on it. Once a designer has gone through the procedure of determining the characteristics of the system at design conditions, he is loath to repeat the process several times more in order to plot a system curve.

Fortunately, it is often quite simple to plot a system curve once the design point has been established. Such curve can serve as a useful design tool for visualizing system operation under varying conditions.

Graphical representations can show, among other things, the effects of changes within the system itself, such as aging, errors in assumptions and computations, design changes, and variable operating conditions.

Before constructing a system graph, one must determine which properties are important enough to warrant a graphical analysis. Next, the degree of precision required, together with its corollary, the degree of precision obtainable should be ascertained. Factors which bear on precision obtainable are: (1) accuracy of computational instruments, (2) safety and fouling factors, (3) accuracy of assumptions and basic data, and (4) accuracy of formulas. Finally, the designer should look for ways to simplify systemic relationships and try to determine the range of values required; these can have an important bearing on the time required to construct the graph.

Piping systems using volute type centrifugal pumps are particularly adaptable to this type of analysis. Examples illustrating the usefulness of system curves will therefore be built around such a system. Four cases will be considered.

Example 1

Figure 1 illustrates a simple piping system using a centrifugal pump to deliver water from one vessel to another vessel at a higher elevation. It is desired that the system perform satisfactorily over its projected life of 20 years. Total head of the system at design

flow of 50 gpm for the conditions which will exist after the system has aged for 20 years is first determined.

The Williams and Hazen empirical formula which follows gives a satisfactory estimate of the friction head for the 20-year-old system when a value of 100 is used for C.

$$H_{f_{100}} = 0.2083(100/C)^{1.85} Q^{1.85}/D^{4.87}$$

where $H_{f_{100}}$ = friction loss, feet of water per 100 feet of pipe,
C = a constant, depending upon the interior pipe roughness,
Q = flow, gpm, and
D = inside diameter of pipe, inches.

Calculation of the total system head will be as follows, using handbook values wherever possible:

Total Head at 50 gpm with Old Pipe:

Static head			20.0 ft
Resistance head			
Suction (2½-inch)			
Actual pipe length	20.0 ft		
1 elbow	6.2		
1 gate valve	1.3		
Total equivalent length	27.5 ft		
Friction head, 0.275 × 3.56 ft / 100 ft		1.0 ft	
Velocity head		0.2	
Entrance loss, ½ velocity head		0.1	
Total suction resistance head		*1.3 ft*	
Discharge (1½-inch)			
Actual pipe length	30.0 ft		
3 elbows @ 4.1	12.3		
1 Check valve	10.4		
1 gate valve	0.9		
Total equivalent length	53.6 ft		
Friction head, 0.536 × 28.5		15.3 ft	
Difference in velocity heads		0.8	
Total discharge resistance head		*16.1 ft*	
Total resistance head			17.4
TOTAL HEAD			37.4 ft

Since the system will begin life with new pipe, system performance under that condition must be known. Reference to handbook data reveals that using 130 for C in the Williams and Hazen formula will give a satisfactory friction head value for the new pipe, and that the friction head when C equal to 130 is 0.62 times the friction head when C equal to 100. With his information, it is relatively simple to estimate the head at 50 gpm when the system is new.

With C = 100, friction head was found to be:

Suction	1.0 ft
Discharge	15.3
Total	16.3 ft

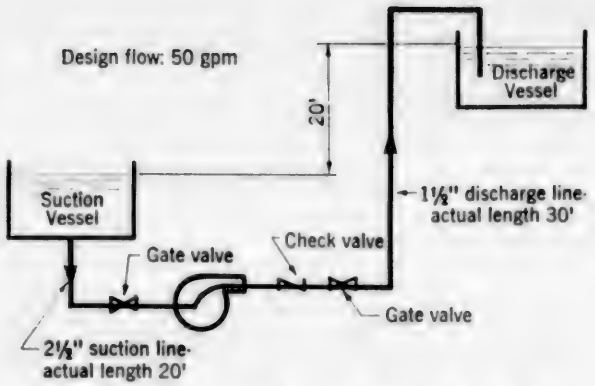

Fig. 1. A simple piping system, used in example 1.

With C = 130, the *reduction* in friction head is $16.3 \times (1.00 - 0.62) = 6.2$ ft.

Total Head at 50 gpm with New Pipe:

Static head	20.0 ft
Resistance head (17.4 – 6.2)	11.2
TOTAL HEAD	31.2 ft

Since the same pump will be used throughout the life of the system, expected performance under both new and old conditions needs be known. To find this requires plotting the pump characteristic together with the system characteristic for each of the two conditions.

Inspection of the Williams and Hazen formula reveals that, for a given system arrangement, friction head varies directly as the 1.85 power of the flow. Similarly, the velocity head and entrance loss vary directly as the square of the flow. Since the sum of these components accounts for all of the resistance head, the expression for resistance head is

$$H_r = K_r Q^2 + K_f Q^{1.85}$$

where H_r = system resistance head, ft,
K_r and K_f = constants of proportionality, and
Q = flow, gpm.

Calculation of resistance head for a given flow would be greatly simplified if an expression in which resistance head varies as some power of flow could be used. Such an expression would have the form:

$$H_r = K_r Q^n$$

where H_r = system resistance head, ft,
K_r = constant of proportionality,
Q = flow, gpm, and
n = some exponent, as yet undetermined.

In this particular example, as is usually the case, friction head accounts for a much higher proportion of total resistance head than does velocity head and entrance loss. This would indicate that using 1.85 as the value for n should result in a fairly close approximation of the resistance head. On the other hand, being able to use *2* for n would greatly simplify the calculations by avoiding the fractional exponent.

Table I was prepared to show the difference in calculated resistance heads, expressed as a percentage of the resistance head at design conditions, which would result from using these two values of n. Since actual resistance head falls somewhere between the two, the error introduced by using either value is smaller than the tabulated difference.

Table I shows that, if flow does not exceed design (in this case 50 gpm) by more than 30%, the error in calculated resistance head using $n = 2$ will be less than 6.5% of the resistance head at design conditions. In this example the design value of resistance head for old pipe, the worst condition, is 17.4 ft.

Since 6.5% of 17.4 ft is only slightly more than 1 ft, and the difference between new and old pipe accounts for a difference in resistance head greater than 6 ft, it can be seen that the error introduced by assuming that resistance head varies directly as the square of the flow would not be significant.

The relationship between flow and resistance head may therefore be written:

$$H_r = K_r Q^2.$$

TABLE 1—MAXIMUM PERCENTAGE ERROR IN CALCULATED RESISTANCE HEAD

(Table shows the difference in calculated resistance heads, expressed as a percentage of the resistance head at design conditions, which would result from using $n = 1.85$ and $n = 2$ in the expression $H_r = KQ^n$. Actual H_r falls somewhere between the two, thus the maximum error, using either value, is less than the tabulated difference.)

Flow, Percent of Design Flow $Q / Q_d \times 100$	Difference between Resistance Heads when exponent is 1.85 and 2, Percent of Resistance Head at Design Flow $(K_1Q^2 - K_2Q^{1.85}) / H_{rd} \times 100$
10	− 0.4
20	− 1.1
30	− 1.8
40	− 2.4
50	− 2.7
60	− 2.9
70	− 2.7
80	− 2.2
90	− 1.3
100	0
110	+ 1.7
120	+ 3.9
130	+ 6.5
140	+ 9.6
150	+ 13.3

Q_d = Flow at design conditions, gpm.
Q = Flow used to calculate H_r at conditions other than design, gpm.
H_{rd} = Resistance head at Q_d, ft.
H_r = Resistance head calculated at Q, ft.
K_1 = Constant of proportionality = H_{rd} / Q_d^2.
K_2 = Constant of proportionality = $H_{rd} / Q_d^{1.85}$.

Using Q_d (flow at design conditions) as 50 gpm, for old pipe:

$$K_r = 17.4/50^2 = 6.96 \times 10^{-3},$$

and for new pipe

$$K_r = 11.2/50^2 = 4.48 \times 10^{-3}.$$

With these constants determined, it is a simple matter to calculate resistance heads at various flows. It is a good idea to set the flows at even gallons per minute. The slide rule index may then be placed on K_r and values of H_r read directly and quickly by multiplying by the square of the flow.

A tabulation of the calculated resistance heads for both new pipe and old pipe follows:

		$H_r = K_r Q^2$	
Q	Q^2	*New Pipe*	*Old Pipe*
10	100	0.5	0.7
20	400	1.8	2.8
30	900	4.0	6.3
40	1600	7.2	11.1
50	2500	11.2	17.4
60	3600	16.1	25.0
65	4225	18.9	29.4

The two sets of calculated data are plotted, as shown in Fig. 2, by adding static head, which remains constant, to resistance head for the corresponding flow rate. For illustrative purposes, the entire flow range from 0 to 65 gpm (130% of design flow) is plotted; however, the purpose of the curves could be served equally well by restricting the values to a much smaller range.

A pump is selected which has the performance characteristics shown in Fig. 2. Note that it is capable of delivering the required 50 gpm with old pipe in the system. When the pipe is new it will deliver about 56 gpm. Assuming pump efficiencies of 65% at 50 gpm and 62% at 56 gpm, we find that the brake horsepower with new pipe is 0.78 as against 0.73 with old pipe. Ordinary prudence dictates that the pump prime mover be selected to meet the higher condition or that an adjustable resistance be placed in the system to reduce the flow during the early years.

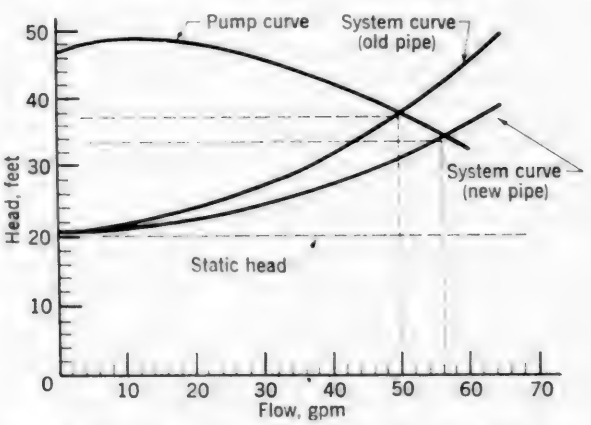

Fig. 2. System curves for new and old pipe show how flow will be affected by increasing friction.

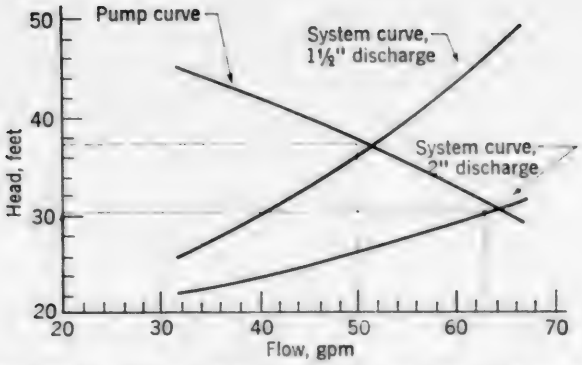

Fig. 3. Intersections of pump curve with 1½- and 2-inch discharge system curves show the effect of specifying the larger pipe size: an increase of 13 gpm. See example 2.

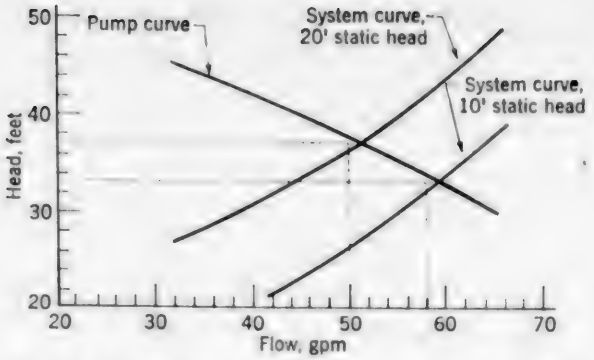

Fig. 4. Intersections of pump curve with system curves for 10- and 20-ft head show how flow is reduced 8 gpm when static head is doubled. See Example 3.

Example 2

It is often advantageous to know what effect a change in pipe size will have on a system. Again, it is well to study the relationships of system components to determine whether computations can be simplified.

For the system in Fig. 1, assume that it is desired to know the results of increasing the discharge pipe diameter from 1½ to 2 inches.

Inspection shows that the equivalent length of a pipe fitting is directly proportional to its inside diameter. (That is why equivalent lengths of fittings are often expressed as equivalent pipe diameters.) This fact makes it easy to determine total equivalent length of the 2-inch discharge line from information already gained in computing the 1½-inch line.

Calculation of the head requirements at 50 gpm, using 2 inch pipe for discharge, is as follows:

Equivalent length of fittings for 1½-inch pipe	= 23.6 ft
Equivalent length of fittings for 2-inch pipe, 23.6 × 2/1.5	= 31.4 ft
Total equivalent length of 2-inch discharge pipe = 31.4 + 30	= 61.4 ft

Total Head at 50 gpm with 2-inch Discharge (Old Pipe)

Static head		20.0 ft
Resistance head		
Discharge (Old Pipe)		
Friction head, 0.614 × 8.46 ft/100 ft	5.2 ft	
Difference in velocity heads	0.2	
Total discharge resistance head	5.4 ft	
Discharge resistance head, 1½-inch pipe	16.1 ft	
Discharge resistance head, 2-inch pipe	5.4	
Difference	10.7 ft	
Total resistance head (17.4 − 10.7)		6.7 ft
TOTAL HEAD		26.7 ft

The two curves for 1½- and 2-inch discharge piping are plotted over the range of 20 to 65 gpm in the same manner as was done for Fig. 2, resulting in the graph shown on Fig. 3. Using the same pump as selected for Example 1 (Fig. 2) results in a system capable of delivering approximately 63 gpm with a 2-inch discharge pipe as against 50 gpm with 1½-inch pipe.

The relationship illustrated in this example can be quite useful when there are a large number of fittings in a piping system.

Example 3

Variation in static head is often encountered in pumping systems, the result of changes in relative liquid levels between the suction and discharge vessels or of pressure variations within the system itself. A hydro-pneumatic water supply system is an example.

Plotting curves for these systems is quite simple. First, the curve for one static head condition is plotted in the normal manner. Then the other curve is plotted by adding or subtracting the difference in static heads for each point.

Using the original system pipe sizes and configuration, and assuming a variation in static head of 10 ft, there results the curves shown in Fig. 4. There is a variation in flow of 50 to 58 gpm. Naturally, all system components must be capable of meeting every condition encompassed within the flow range.

Example 4

Oftentimes the liquid itself will exhibit changes in properties, as when viscosity varies as a result of temperature changes. A snow melting system, using a petroleum base heat transfer oil, is an example. A change in viscosity has a doubly complicating effect. Both piping system and centrifugal pump undergo changes in characteristics.

Again, the system shown in Fig. 1 will illustrate the point. If it is assumed that the liquid being pumped can vary in viscosity from 31.5 SSU (similar to water) to 300 SSU, and that the liquid is such that little fouling will occur during the life of the system, then new-pipe friction losses may be assumed throughout its life.

The Williams and Hazen formula used for pipe friction in the preceding examples applies only to liquids with viscosities close to that of water. It is therefore necessary to use the rational Fanning formula for friction losses when viscosity is 300 SSU. This viscosity, together with the flow range and pipe sizes encountered in this problem, results in laminar flow. As a consequence, surface roughness does not affect the friction head requirements. In addition, friction head varies directly as the rate of flow.

Using the same methods (except for the different friction head formula) employed in calculating the head for Fig. 2, the results are as follows:

Total Head at 50 gpm and 300 SSU

Static head		20.0 ft
Resistance head		
Friction head	17.8 ft	
Velocity head and entrance loss	1.1	
Total resistance head		18.9
TOTAL HEAD		38.9 ft

Velocity head and entrance loss are a relatively small proportion of resistance head. Furthermore, data on the exact nature of entrance losses under laminar flow conditions are relatively meager. These facts indicate that using a direct variation in resistance head with flow would result in an estimate of sufficient precision for the purpose.

Turning to pump performance, we find that, at 300 SSU, the characteristics will be modified with respect to the performance at 31.5 SSU by the following factors: capacity, 0.973; head, 0.947; efficiency, 0.728. The pump characteristics are adjusted by multiplying the values at 31.5 SSU by the corresponding factors. These adjustments result in the following performance characteristics throughout the range of 30 to 60 gpm:

31.5 SSU		300 SSU	
Flow, gpm	*Head, ft*	*Flow, gpm*	*Head, ft*
30	45	29	43
40	42	39	40
50	37	49	35
60	33	58	31

Plotting the pump curves and the system curves for both viscosity conditions results in the graph shown in Fig. 5. As can be seen, the increase in viscosity has a doubly adverse effect. Not only is the head increased appreciably, but capacity of the pump is also reduced. This compound effect reduces the flow from 56 gpm to 45 gpm. Added to this is the marked reduction in efficiency, which at 300 SSU is reduced to 0.728 of its value at the corresponding flow at 31.5 SSU. If it is assumed that the specific gravity is 1.0 under both conditions, and that at 31.5 SSU the efficiency for each corresponding flow is 62%, at 300 SSU the efficiency would be 0.728 × 62 = 45%. Brake horsepower at 31.5

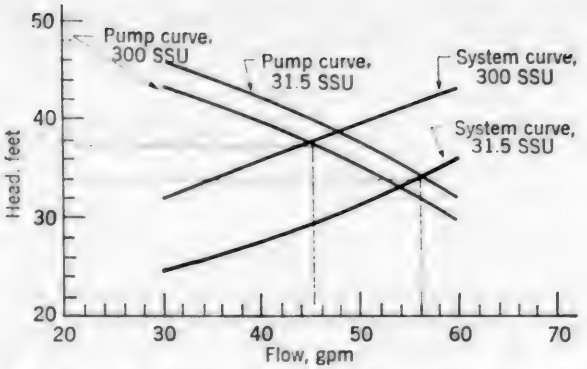

Fig. 5. Graph shows how flow varies with viscosity of fluid.

SSU would be 0.78 and at 300 SSU, 0.94. The increase in viscosity has resulted in a decrease in flow coupled with an increase in power requirements.

Other Systems

There are many other variations in pumping systems which can be analyzed graphically. Pump speed, impeller diameter, and partially open control valves are a few of the factors which lend themselves to this procedure.

Other types also lend themselves to graphical methods of solution. Air handling systems for ventilation and air conditioning have properties quite similar to those of piping systems. Graphs can be an especially useful tool for systems employing forwardly curved centrifugal fans. The rising power characteristic of this type fan often makes it desirable to know the effects of lowered system pressures in order to avoid overloading the prime mover.

The design of systems involving natural draft chimneys can be facilitated with the use of graphs. At given outside air and flue gas temperatures, the capacity of such a system can be represented by the static draft (a constant value) minus the system resistance (a value varying with flow). Therefore a curve of available draft versus flue gas flow has an appearance similar to a piping system curve except that it is inverted; i.e. flow increases with draft head.

Conclusion

The examples given indicate only a few of the possibilities of graphical representation. Whenever a designer is confronted with a problem in which system conditions can vary it may be advisable to investigate the possibility of constructing a graph of system performance. When making such an investigation it is always well to bear in mind the following major steps which can help to reduce materially the amount of time required:

(1) Look for mathematical relationships among system characteristics. (2) Seek ways in which these relationships can be simplified without introducing errors larger than warranted by the degree of precision required. (3) Determine the range of values necessary to properly illustrate the desired features. Keeping these points in mind will do much to provide useful graphical analyses.

Predicting the Performance of

Reverse-Jet Filters

Two methods, one analytical and one graphical, are offered to simplify the complex problem of predicting performance of reverse-jet filters under various operating conditions.

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The basic principle of the reverse-jet filter involves the maintaining of porosity in a relatively deep bed of fine fibers so that continuous high-flow-rate performance at high efficiency may be maintained. The specific method first developed involves the passage of a small volume, high velocity jet of air in the reverse direction to the normal flow of filtering air. Felt or a felt-like substance must be used as the filtering medium, because a relatively deep, homogenous bed of fibers of reasonable mechanical strength and flexibility is required. A round torus with a slot on the inside surface, or "blow ring", is moved slowly up and down a vertical felt tube to provide the reverse-jet action. The behavoir of the basic design is illustrated in Fig. 1.

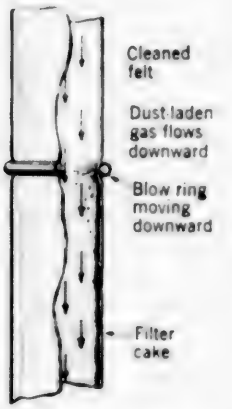

Fig. 1. Basic action of reverse jet. Blow ring injects air inward through felt tube removing dust cake deposited by outflowing air. As ring moves up and down, dust cake falls to collecting hopper (not shown) at bottom. Courtesy of Western Precipitation Corp.

Efficiency

The efficiency of this type of filter is sufficiently high to represent 100% dust collection, for all practical purposes, in most industrial applications. A collection efficiency of 99.9 weight % minimum, to 99.99 weight % or better, is obtained if the entering dust load is 0.01 gr per cu ft or higher. Several sets of efficiency data have been published (listed in Table 1) and all except one set support the above conclusion. It is interesting to note that the single set of data yielding lower efficiences was obtained by testing random industrial installations on an "as is" basis with no check to determine the condition of the bags, etc. Collection efficiency is not a function of particle size at these inlet loadings.

Performance

The performance in terms of filtering velocity and resistance is, however, somewhat more difficult to predict and is affected by many variables. The most important of these is the nature of the dust, which will be discussed in detail later. As ground work for discussion of the methods of predicting performance, the general operating ranges will be discussed.

Operating Ranges

Filtering velocity in actual practice covers the range of 3 to 54 cfm per sq ft at reasonable resistances. The higher end of the range, however, frequently leads to a troublesome installation. It is the general consensus of opinion among the manufacturers and experienced users that the upper practical limit for smooth operation should be 20 to 25 cfm per sq ft.

Filter resistance for the usual design should be limited to a maximum of 8 inches w.g.; usual design objective is for the range of 3 to 5 inches w.g. A resistance of less than 1 inch is not practical, because pressure less than this will fail to fully inflate the filter tube and the cleaning action of the blow rings will not be effective. Resistance higher than 8 inches will result in excessive bag wear, perhaps in lowered efficiency, and is not practical anyway for the usual application using standard industrial exhausters.

Blow ring travel speed varies with the different commercial designs. As manufactured, standard ring speeds may be obtained from 20 to 50 fpm. The basic reason for the persistent difference of opinion is probably that there is a different optimum ring speed for each different dust. During the downward trip of the blow rings, the reverse-jet action blows a cloud of dust off the inside of the filter tube and has a tendency to "chase" the suspended cloud of dust downward to the collection hopper. If the ring travel speed is properly matched to the natural settling velocity of the suspended cloud of agglomerates, this action is very effective. If the travel speed is to slow, a portion of the dust already cleaned off the tube will re-deposit lower in the tube. If the ring speed is too fast, the dust will re-deposit on the just-cleaned portion of the tube above the blow ring.

The validity of this theory is supported by many field observations. For example, a ring speed of 20 fpm has been found optimum for light dusts such as grain dust and flour. In the collection of high density

uranium dusts, a beneficial effect is always obtained by increasing the ring speed to 40 or 50 fpm.

The situation is complicated by the fact that increasing the ring speed does not increase the cleaning action of the reverse-jet in any simple fashion. Because the reverse-jet slot in the blow ring has a finite width, the jet acts on a given point on the filter tube for a finite period of time as the ring passes that point. Increasing the ring travel speed will get the jet back to that point more frequently, but for a shorter period each time.

The blow ring travel speed of a given unit can be changed rather easily in the field if necessary. It may be possible, with increased application experience, to group typical dusts into several classes for which the optimum ring speed could be approximated, step-wise, at intervals from 20 to 50 or 60 fpm.

Reverse-jet air volume and velocity data have been published (Items 1 and 2 in Table 1) which show that filter resistance decreases with an increase in slot width if either slot velocity or total reverse-jet volume is held constant. Obviously if jet velocity is held constant, increasing the slot width increases the total amount of reverse-jet air.

The usual optimum range of reverse-jet air volume is 1.0 to 1.5 cfm per linear inch of slot. Slot widths furnished by various manufacturers vary from 0.030 to 0.25 inch. Within the normal operating ranges, an increase in jet air volume will decrease the filter resistance, of course at increased cost for the reverse air blower and at increased power cost for its operation at the higher rating.

Laboratory data in the Harvard report listed in Table 1 and the author's own field experience indicate that for a heavily loaded filter operating in the range of 6 to 8 inch w.g. resistance, 75 to 80% increase in reverse-jet air volume will decrease the filter resistance about 25%.

There has been a recent trend to use larger slot widths than formerly, thus permitting the use of relatively inexpensive, low maintenance centrifugal blowers as a source of reverse-jet air pressure. Although theoretically a constant volume air pump such as a Roots or Sutorbilt blower should be used to maintain reverse-jet volume in spite of any increases in filter resistance, the use of centrifugal blowers seems to have worked out well, especially for lighter loads and easily filtered dusts.

TABLE I—REVERSE-JET PERFORMANCE DATA SOURCES

(1) C. E. Billings, M. W. First, R. Dennis, and L. Silverman, Harvard School of Public Health Report NYO 1590, August 31, 1954.

(2) H. J. Hersey Jr. and K. J. Caplan, Hersey Filter Laboratory Progress Reports, 1952-54.

(3) K. J. Caplan, "High Efficiency Collection of Radioactive Dust", Heating and Ventilating, February 1951.

(4) K. J. Caplan, "A Self-Cleaning Air Filter—Details of the Hersey Reverse-Jet Filter" Chemical Engineering Progress, August 1954, Vol. 50 No. 8.

(5) K. J. Caplan and M. G. Mason, "Efficiency of Reverse-Jet Filters in Uranium Refining Operations" AEC Air Cleaning Seminar, Ames, Iowa 1952.

In predicting the performance of a dust filter, the physical and chemical nature of the dust itself is the most important variable. Although equations relating the basic physical and chemical properties of dust particles to filteration can be derived, the determination of these basic parameters and their application to the practical case requires more time and expense, and is less certain in its result, than a more empirical approach.

Two methods of predicting performance, one analytical and one graphical, have been developed. Both methods depend upon data for at least one operating point of a filter *on the dust in question.* Such prior knowledge is best gained from a full-scale installation on the same, or closely similar, dust. If such data are not available, a pilot test of several hundred operating hours will yield reliable data.

Laboratory tests of short duration are not as reliable a basis for performance design for several reasons. First, a long test period of from 50 to 200 hours is usually required for the filter to approach equilibrium, unless the dust load is abnormally high. Such a long laboratory test is at best inconvenient, and at worst may be so difficult as to be almost impossible. Secondly, it is difficult to disperse the sample dust into the air stream to the same degree as will be later encountered in the field installation. Laboratory data can and have been used successfully, however, if generous safety factors are used.

The analytical method for predicting performance was developed at Harvard University (Item 1, Table 1) and takes the form

$$R_f = C_1 V (L + C_2)^n + \frac{(C_3 - V_j) C_4 J_f^m}{1000} \qquad (1)$$

where:

R_f = filter resistance, inches w.g.
V = filtration velocity, cfm per sq ft
L = dust load to filter, grains per (min)(sq ft)
V_j = velocity of reverse-jet, fpm
J_f = reverse-jet operating time
n, m = experimentally determined exponents
$C_1 - C_4$ = experimentally determined constants

The application of the equation (1) in practice is usually inconvenient. Even if full scale operating experience on the subject dust is available, it is necessary to operate the filter over a range of dust loads and filtering velocities in order to evaluate the constants. Furthermore, a new projected application is somewhat predictable in terms of dust concentration in grains per cubic foot (Gr) but not in terms of L. The variables Gr and L are related as follows:

$$L = GrV \qquad (2)$$

and V is usually the unknown to be determined. Thus, even if the constants have all been evaluated, one must resort to trial and error calculations or a determination of a non-integral power function of V to obtain the desired result.

A graphical solution is derived directly from a single set of known operating conditions of filtering velocity, resistance, and dust load, by separating the variables of filtering velocity and dust load. Dust load of significance to the filter is in weight per unit time

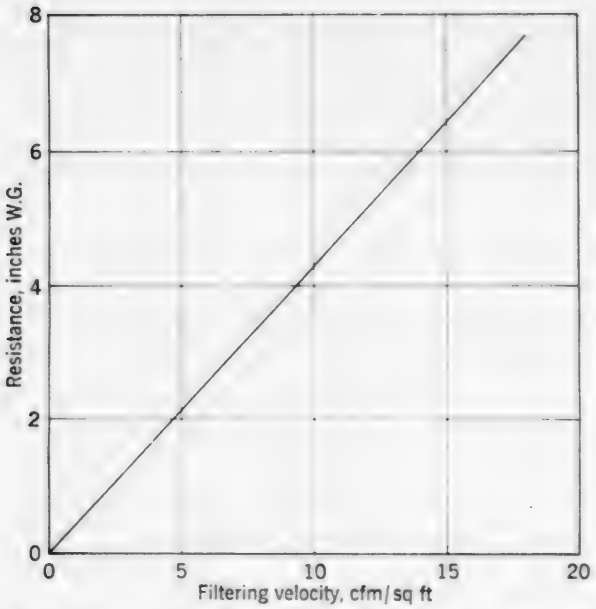

Fig. 2. Filter resistance vs. volume at constant absolute dust load.

per unit filter area, and the usual Gr concentration must be converted to such units by equation (2).

Upon separating the variables, one finds that filter resistance varies directly and linearly with filtering velocity as shown in Fig. 2 as long as the absolute dust load L is constant. Similarly, with the filtering velocity constant, the relation log R vs. log L results in straight line of slope 4, as shown in Fig. 3. The Harvard data, if treated in the same manner, and even though determined by short runs, yield slopes varying from 3.7 to 5.5 and averaging 4.75, for four different dusts. The lower the slope of this line the more conservative the prediction of performance, so the value of 4 is used in this graphical method.

The variables V, L, and K can be combined on one chart as a family of curves shown in Fig. 4. One known operating point locates the point labeled "original data", and a line of slope =4 is drawn through this point. Parallel lines spaced in proportion to the filtering velocity at the same absolute dust load are drawn to represent the performance at other filtering velocities, thus representing the total performance picture of the filter on that particular dust; all at constant blow ring slot width, blow ring travel speed, reverse-jet air volume, etc.

The determination of predicted performance is by an easy trial and error method, illustrated by Fig. 4.

Original data:

Dust concentration Gr = 0.8 gr per cu ft
Filtering velocity, V = 16 cfm per sq ft
Filter resistance, R = 4.4 inch w.g.
L = 0.8 x 16 = 12.8 gr per (min) (sq ft)

Case I Determine the design filtering velocity for the same dust, for an anticipated dust concentration of 2.5 gr per cu ft, so that the resistance does not exceed 5.0 inch w.g.

Trial 1. Estimate resistance at same filtering velocity, 16 cfm per sq ft.

V_1 = 16 cfm per sq ft
L_1 = 2.5 x 16 = 40 gr per (min) (sq ft)
R_1 = 5.8 inch w.g. (from chart)

Trial 2. Adjust V_1 by ratio of desired resistance to R_1

$$V_2 = \frac{5.0}{5.8} \times 16 = 13.8 \text{ cfm per sq ft}$$

L_2 = 2.5 x 13.8 = 34.5 gr per (min) (sq ft)
R_2 = 4.8 inch w.g. (from chart)

Trial 3. Adjust V_2 by ratio of desired resistance to R_2

$$V_3 = \frac{5.0}{4.8} \times 13.8 = 14.4 \text{ cfm per sq ft}$$

L_3 = 14.4 x 2.5 = 36.0 gr per (min) (sq ft)
R_3 = 5.05 inch w.g. (from chart)

Case II Determine the design filtering velocity for the same dust, for an anticipated dust concentration of 0.25 gr per cu ft, so that the resistance does not exceed 3.5 inch w.g.

Trial 1. Estimate resistance at same filtering velocity, 16 cfm per sq ft.

V_1 = 16 cfm per sq ft
L_1 = 0.25 x 16 = 4.0 gr per (min) (sq ft)
R_1 = 3.3 inch w.g. (from chart)

Trial 2. Adjust V_1 by ratio of desired resistance to R_1

$$V_2 = 16 \times \frac{3.5}{3.3} = 17 \text{ cfm per sq ft}$$

L_2 = 17 x 0.25 = 4.25 gr per (min) (sq ft)
R_2 = 3.65 inch w.g. (from chart)

Trial 3. Adjust V_2 by ratio of desired resistance to R_2.

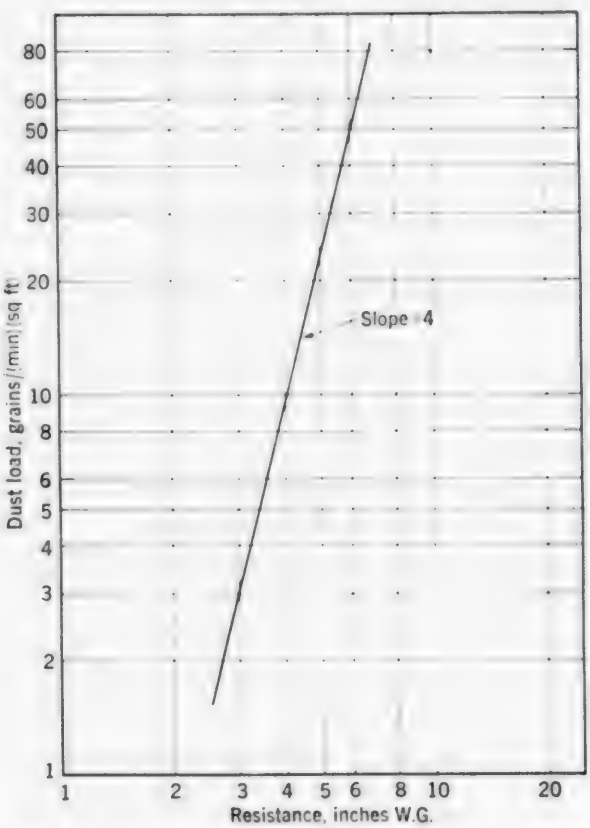

Fig. 3. Filter resistance vs. dust load at constant volume.

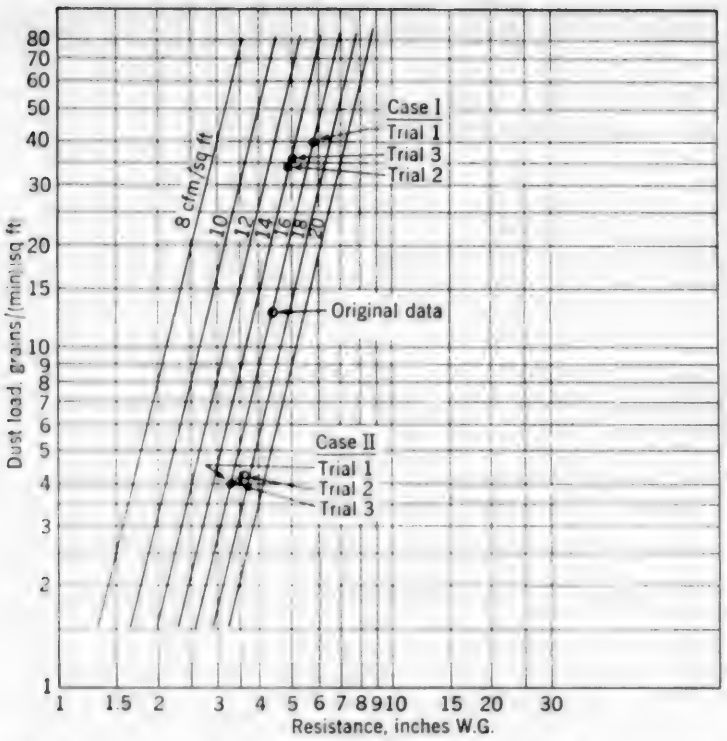

Fig. 4. Combined air volume—dust load—resistance performance chart.

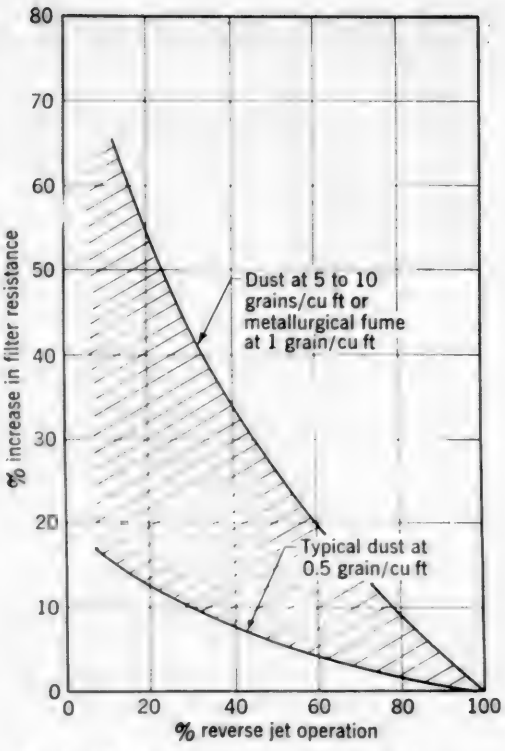
% increase in filter resistance
% reverse jet operation
Dust at 5 to 10 grains/cu ft or metallurgical fume at 1 grain/cu ft
Typical dust at 0.5 grain/cu ft

Fig. 5. Effect of pressure control on filter resistance.

$$V_s = \frac{3.5}{3.65} \times 17 = 16.5 \text{ cfm per sq ft}$$

$$L_s = 16.5 \times 0.25 = 4.12 \text{ gr per (min)(sq ft)}$$

$R_s = 3.5$ inch w.g. (from chart)

Case III On the existing filter installation, hooding is to be revised so that more dust will be collected. It is estimated that the total dust load will be doubled. What will the new filter resistance be?

Solution: Follow the 14 cfm per sq ft line to a load of 25.6 gr per (min)(sq ft), read
New resistance = 5.2 inch w.g.

Case IV On the existing filter installation, it is desired to increase the fan speed and add duct work to provide ventilation for a new process. The additional air load would increase the filtering velocity from 14 to 18 cfm per sq ft, but little or no additional dust is to be collected. What is the new filter resistance?

Solution: Follow the 12.8 gr per (min)(sq ft) line to 18 cfm per sq ft line, read.
Resistance = 5.2 inch w.g.

Pressure Control

If the unit is to be operated on pressure control, an additional allowance for filter resistance must be made. The graphical method is valid for 100% blow ring operation, or where the "original data" unit and the new unit are both to operate at the same percentage on-time for the blow rings. For an installed unit, it is easy to obtain 100% ring operation merely by lowering the set point of the control until the blow rings operate continuously. Pilot data or laboratory data will also usually be obtained on this basis.

The variation of filter resistance with blow ring operation is shown in Fig. 5. This variation covers quite a large spread and it is obviously difficult to predict the percent blow ring operation with exactness For the typical case, a 10 to 20% reduction in filtering velocity below that predicted by the graphical method will provide satisfactory pressure control operation. For the more difficult filtering applications typified by the upper side of the spread, pressure control is less advantageous during full-load periods. It still serves the beneficial purpose of shutting off the blow rings when the dust load is greatly reduced due to process inactivity, which is a surprisingly large percentage of the time in many industrial operations.

The graphical method of predicting performance was used with complete success in sizing fifteen new filter installations for a new uranium refinery which went on stream in 1957. All the new units operated within expected ranges, once the mechanical start-up problems were corrected. In this connection, the nature of the dust as the most important variable was re-emphasized. In one process application, the filter was sized for a velocity of 16 cfm per sq ft based on prior experience and the graphical method. The process itself was then changed, so that the dust generated, although of the same chemical composition, was of different physical properties. In spite of the fact that dust loading was lower than for the old process, the filter would not handle the load at a reasonable resistance. Based on the new experience, a filtering velocity of 8 cfm per sq ft. was calculated, and additions were made to the filter installation to double the filtering area. This step proved successful, again validating the graphical method but emphasizing the importance of the nature of the dust.

Optimizing Primary Coolant Piping for Nuclear Power Plants

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Since a physical piping layout is usually required at an early stage of the nuclear power plant design, the unusual features involved in this particular design step require some investigation. This article presents a rational approach to this problem. Equations and tools provided by conventional engineering design practices are developed to yield optimum pipe diameters and velocities for given amounts of fluid to be transported.

IT IS usually desirable in a design of this type to utilize one pipe to carry the total flow under normal economical and technical conditions. This selection can normally be justified on purely economical terms without fixing the particular optimum velocity. For nuclear power plant systems, the total flow is usually split into more than one coolant loop. Among the reasons for this trend are the necessity for a standby or spare loop, and practical size limitations on pumps, valves and piping. Other less easily discernible, but nevertheless powerful factors, are system control, startup, shutdown, emergency and/or scram conditions. Additional factors influencing the number of loops required may be due to reactor vessel or reactor coolant tubing geometry and containment.

The latter item is frequently of considerable importance since the containment vessel design is usually based on a primary coolant system rupture. Since the rate of loss of coolant and the pressure rise in the containment vessel are obviously dependent on pipe size, this factor often governs confinement considerations.

The maximum pipe size and the least number of loops required can be determined by investigating all these factors. Fortunately, several guideposts are available for this preliminary evaluation. Conventional commercial experience indicates that, for a given velocity, the least number of loops or the maximum pipe size will result in the lowest cost. Naturally, this condition also applies to the design of nuclear power plants.

After optimizing for the most economical pipe velocity, the piping system design will be based on either the maximum pipe diameter or the minimum number of coolant loops, whichever condition is the limiting factor. This is dependent on the magnitude of the primary coolant flow rate.

Economic Evaluation

Two factors primarily determine the most economical or optimum velocity of the primary coolant within the piping system. These variables are similar in most economic evaluations, and can be defined as the capital cost and the operating cost.

Annual accounting methods will be utilized to determine the most economical or optimum velocity. Some of the factors affecting the capital cost are the pump, piping, valves, pipe insulation, and the cost of primary coolant fluid. Only the pump and piping costs will be considered for the purpose of this analysis.

The pump cost is defined in terms of dollars per horsepower. This represents a convenient method of assessing incremental pump cost due to head losses in the piping system. Naturally, the pump cost must include all pump accessories such as drive, couplings, gears, and flywheels.

Piping cost is defined in terms of dollars per pound of piping material. This method of accounting does not lend itself to a general definition of piping cost. However, the pricing of piping systems by means of a constant price per pound is permissible when parameters such as material, diameter, wall thickness, frequency of welds, joints and bends have been defined. This approach is certainly superior to the frequently used method of pricing piping by unit of length. The latter method neglects to take into consideration wall thickness variations with corresponding changes in diameter.

Operating cost refers primarily to the cost of pumping through the piping system, and represents an energy charge. Secondary items such as maintenance and heat losses through insulation are neglected in this analysis, but can be determined for special cases whenever necessary.

The energy charge is defined in dollars per horsepower-year. This definition assumes the existence of a load factor for the piping system which should be similar to the load factor for the power plant. A load factor of 80% is usually considered representative. In order to relate capital costs to annual operating costs, this analysis utilizes a capital recovery factor which allows for such items as amortization, interest, profit, and taxes. This capital recovery factor repre-

sents that fraction of the total capital cost which must be written off annually to result in profitable operation.

Velocity Losses

The use of a constant to express the number of velocity heads lost in a primary coolant loop due only to the piping system, leads to a simplification of this analysis without impairing its accuracy. More rigorous analysis would result in an expression consisting of two terms, the first denoting the friction drop in the loop piping as a function of inside pipe diameter and piping length, and the second term expressing the entrance, exit, bend losses and other shock losses due to valves, etc. The use of this type of approach would add unnecessary complexity to the analysis without significantly improving its accuracy. At the outset, the value of the constant should be estimated based on maximum pipe diameter, loop piping length and the expected shock loss factors. If, after the initial results, any of these factors should change, the end result can be easily modified.

Annual charges due to the capital cost of the pump and piping are $C_2 Ra$ and $C_1 Wa$ respectively.

Annual charges due to the operating cost are $C_3 R$. The total annual charges, therefore, are given by:

$$T = C_2 Ra + C_1 Wa + C_3 R \qquad (1)$$

By proper optimization, the total annual charges should be minimized. Pressure drop due to flow in the piping system only is given by:

$$\Delta p = \frac{HV^2}{2g\, v\, 144} \qquad (2)$$

The actual pump horsepower required due to this pressure drop is given by:

$$R = \frac{Q\, \Delta p}{3.82\ (144) 2g\ E\ v} \qquad (3)$$

Combining equations (2) and (3)

$$R = \frac{QH\, V^2}{3.82\ (144) 2g\ E\ v} \qquad (4)$$

The weight of the piping is given by:

$$W = 12\, Nlr \frac{\pi}{4} (D_o^2 - D^2) \qquad (5)$$

Since

$$D_o = D + 2t \qquad (6)$$

Furthermore, pipe wall thickness can usually be expressed as a linear function of inside pipe diameter

$$t = M D \qquad (7)$$

where M represents a constant which can be determined by using the ASA Code for Pressure Piping formula with the pertaining design pressure, stresses and other factors. Sufficient information for estimating M is furnished in the Appendix.

Combining equations (5), (6), and (7):

$$W = 12\, Nlr\, \pi\, D^2 (M^2 + M) \qquad (8)$$

The flow rate for a nuclear power plant system is usually determined by other considerations, and can be assumed to be constant. Therefore,

$$Q = \frac{\pi}{4} \frac{D^2}{144} V N \qquad (9)$$

Eliminating D by combining equation (8) and (9)

$$W = \frac{6912\ lrQ\ (M^2 + M)}{V} \qquad (10)$$

By substituting equations (4) and (10) into Equation (1)

$$T = \frac{HQV^2}{3.82\ (144)\ 2g\ E\ v} \left(C_2 a + C_3 \right) + \frac{6912\ lrQ\ (M^2 + M)\ C_1 a}{V} \qquad (11)$$

Differentiation of equation (11) with respect to the coolant velocity V and setting the result equal to zero will yield the optimum coolant velocity

$$\frac{dT}{dV} = 0 = \frac{2HQV}{3.82\ (144)\ 2g\ E\ v} \left(C_2 a + C_3 \right) - \frac{6912\, lrQ\ (M^2 + M)\ C_1 a}{V^2}$$

By rearranging terms

$$V_{opt} = 496 \left[\left(\frac{Elr\, v}{H} \right) \left(M^2 + M \right) \right]^{1/3} \left[\left(\frac{C_1 a}{Ca_2 + C_3} \right) \right]^{1/3} \qquad (12)$$

For installations where first cost should be minimized, or whenever energy charges can be neglected (viz.—for experimental facilities, low use factor applications, and other instances of short payout time) the energy charge term can be omitted from equation (12).

$$V_{opt} = 496 \left[\left(\frac{Elr\, v}{H} \right) \left(M^2 + M \right) \right]^{1/3} \left[\left(\frac{C_1}{C_2} \right) \right]^{1/3} \qquad (13)$$

Design Problem

Note that equation (12) is independent of the total coolant flow rate, the piping diameter and the number of loops required to carry the total flow rate. The optimum coolant velocity given by equation (12) can be determined by evaluating the right side of the equation. The first bracket contains physical variables such as pump efficiency, properties of piping material

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TABLE I—CONSTANT M FOR VARIOUS P & S VALUES

Design Pressure,	Piping Material Allowable Stress, S				
	2,000	5,000	10,000	15,000	20,000
P	M	M	M	M	M
500	0.147	0.532	0.0258	0.0170	0.0127
1000	0.357	0.114	0.0532	0.0347	0.0258
1500	0.681	0.183	0.0824	0.0532	0.0392
2000	—	0.263	0.114	0.0725	0.0532
2500	—	0.357	0.147	0.0925	0.0675
3000	—	0.469	0.183	0.114	0.0824
4000	—	0.770	0.263	0.159	0.114

and coolant, piping design pressure and geometry. The second bracket on the right side of equation (12) contains factors related to the economic aspect of the problem. No appreciable simplification beyond equation (12) can be achieved without compromising accuracy. The relationship existing between the length of piping per loop l and the number of velocity heads lost in a piping loop cannot be utilized since Q, N and D would be reintroduced into the final equation and, as pointed out before, because of the difficulty of handling shock losses. To illustrate the use of equation (12), assume a system with the following conditions:

$E = 0.85$	an assumption based on standard centrifugal pump designs
$r = 0.283$ lb per cubic inch	for stainless or carbon steel piping
$V = 0.0184$ cu ft per lb	for water at 2000 psi and 400 deg F
$l = 250$ ft	an assumption based on general knowledge of plant layout
$H = 10$	an assumption based on plant layout
$C_2 = \$100$ per hp	for pressurized water circulating pumps with driver and accessories
$C_1 = \$2$ per lb	for stainless steel piping of relatively large diameter including welding, installation, insulation and hangers.
$C_3 = \$18.3$ per hp-yr	for an energy charge of 3.5 mils per kw-hr and a load factor of 80%
$a = 0.0574$—1 yr	for 25 year amortization with 3% funding
$M = 0.073$	for 2000 psi design pressure and about 14,850 psi allowable stress

$$V_{opt} = 496\left[\frac{(0.85)\ (250)\ (0.283)\ (0.0184)\ (0.0785)}{10}\right]^{1/3} \times \left[\frac{2\ (0.0574)}{100\ (0.0574)\ +\ 19.6}\right]^{1/3}$$

$$= 17.1 \text{ ft per sec}$$

Using the conditions from the illustration above, and determining the optimum velocity for a facility with a minimized first cost utilizing equation (13) results in an optimum velocity of 27.6 ft per sec.

Since any changes in the variables of equation (12) will affect the optimum velocity only to 0.33 power, the usefulness of a preliminary estimate is increased.

As a matter of practical interest, the value of the denominator of the second bracket on the right side of equation (12) indicates that the energy charge is usually the controlling factor, and pump capitalization only a secondary consideration.

Nomenclature

C_1	Piping capital cost	$ per lb
C_2	Pump capital cost	$ per hp
C_3	Energy charge	$ per hp-yr
T	Total annual charges	$ per year
R	Pump horsepower	hp
W	Weight of piping	lb
a	Capital recovery factor	per year
Δp	Pressure drop	lb per sq inch
H	Number of velocity heads lost in a piping loop	
V	Velocity of fluid	ft per sec
v	Specific volume of fluid	cu ft per lb
Q	Total flow rate	cu ft per sec
E	Pump efficiency	
N	Number of piping loops to carry total flow rate Q	
l	Length of piping per loop	ft
r	Density of piping material	lb per cu inch
D_o	Outside piping diameter	inch
D	Inside piping diameter	inch
t	Piping wall thickness	inch
M	Constant relating pipe wall thickness with inside pipe diameter	
g	Gravitational constant	ft per sec per sec
P	Piping design pressure	lb per sq inch
S	Piping material allowable stress	lb per sq inch

The constant M is evaluated in Table 1 by use of the ASA code formula.

$$t = \frac{PD_o}{2S + 0.8P}$$

$$M = \frac{PD_o}{(2S + 0.8P)D} = \frac{P}{2S - 1.2P}$$

How to Balance an Air System

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Balancing a large air system is a time consuming task. However, through proper planning and test procedure, the man-hours required for this work can be greatly reduced. Systems must be balanced for assurance that air quantities delivered approximate the design figures.

BALANCING an air system, whether it is for ventilation, heating or air conditioning, is the function of adjusting and regulating the air delivery through ductwork, plenums, registers, grilles, diffusers and other component parts of a duct system from the initial to the final adjustment, to bring individual air volumes in conformity with specified design requirements.

The method most commonly used is one of trial and error, and is admittedly costly, slow, and very seldom results in a satisfactory balance.

No matter how well a system has been designed on the drafting boards, the precision of adjustment, regardless of the method employed for balancing, will depend and be influenced by the shop details, fabrication and erection. It is quite possible that the fabrication and erection could be so adverse that the desired air quantities from each outlet would or could not be reasonably obtainable. It is, therefore, suggested that the design drawings and the fabricator's shop drawings be checked, prior to system balancing, to determine the extent of the differences, if any, in order to evaluate their bearing on the system pressures and air quantities per outlet.

Balancing an air system can be compared to a juggling act. You have to juggle such items as dampers, grilles, registers and diffusers which usually go through several trial and error settings, and sometimes so many re-settings are required that one is on the brink of cursing the system.

The dampers generally are set at a medium point, somewhere between design air quantities and the point where the engineer's patience runs out. The problem becomes more complicated as the size of the project grows.

There are certain preliminary steps one can take, and various tools readily obtainable, which will help to minimize the job and approach more acceptable results in the end.

The suggested basic steps are as follows:

1. Secure prints which indicate: Capacities in cfm of systems, outlets, etc.; equipment schedules and specifications; Outlet sizes and ductwork sizes; all velocities (mains, branches, outlets, coils and filters); design conditions (outside vs. inside), summer, winter and mid-seasons; flow sheets.
2. Collect for reference all the manufacturers' catalogs, covering the selected fans and other air handling equipment, especially the grilles, registers and diffusers as specified.
3. Obtain all the necessary instruments required for the particular balancing project. Suggested portable instruments are: Draft gage set; air stream thermometers; air velocity meters; speed counter; sling psychrometers, anemometers and wet and dry bulb recorders; and pitot tubes (with rubber tubing).
4. Familiarize yourself with the entire system(s) to be balanced, even to the extent of making free hand sketches, especially as to the control systems involved in air distribution.
5. Develop a form to be used in recording all the necessary data for each branch and main. One suggested form is illustrated in Fig. 1.
6. Before starting fans and pumps, check all driving equipment for required rpm, rotation, slippage (V-

BALANCING OF AIR DELIVERY

System No.—A.C. No. 1E

Branch or Submain—Crane Bay—Branch X

	Outlet-Mark No.	A-1	A-2	A-3	A-4	A-5	A-6	Totals
B)	Outlet Size, Inches	12 x 5	12 x 5	12 x 8	10 x 6	10 x 4	8 x 4	——
C)	Design Air Volume, Cfm	275	275	350	275	150	125	1450 Cfm
D)	% of Branch Total Air Quantity							
E)	CFM—With All Dampers Wide Open							
F)	% Variation From Design ($\frac{\text{Line E}}{\text{Line C}}$)							
G)	Base Outlets (Least Value in Line E)	—	—	—	—	—	125	
H)	Reading After Adjustment to Predetermined Ratio							
J)	% Variation to Design Requirements							
K)	Reading After Final Adjustment							

Fig. 1. Suggested form for recording air delivery data.

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belts especially), and adjust and correct, if necessary to assure proper operation.

Read instructions attached to each instrument before handling, for guidance. Examine each instrument to be assured of no visible damage. Test each instrument for accuracy stipulated in manufacturers' data. Handle the instruments so that their usage is not confusing and dexterity is acquired in their manipulations on the job.

A general inspection of the entire layout is recommended before one should approach the task of balancing. Such silly errors as forgetting to insert the filter media or omitting a splitter damper may well cause a great deal of lost time, and an upset in the total normal operating pressures of the system.

The six items listed are the basic groundwork steps which, if properly executed, will definitely lay a firm foundation for the balancing task, and will make the project more a pleasure than a terrible chore.

When these six items have been taken care of, one can then proceed with the following suggested methods or steps for balancing the ventilation system. These steps hold true for any type of normal low velocity, air supply system.

Balancing Steps in Numerical Order

1. Fully open all ducts and all outlet dampers and grilles. Set, or better still, temporarily lock these in the open position. If allowed (by owner), write the amount of air (cfm) next to the outlet or supply opening. A common method is to tape a piece of paper (on which is the cfm quantity) to the duct or opening collar.
2. Start fans, after checking to see if system components, such as filters, are all "on stream". Check capacity and adjust to design requirements.
3. Select a remote or least favored branch of the system and record its capacity. Then record volume of air from each outlet on this selected branch, and compare this with design quantities.
4. Using capacity of a distant outlet, (base outlet) check the percentage difference to design quantity.
5. If percentage under item 4 is greater than 1, reduce total air volume to branch to approach distant outlet design capacity. This is usually accomplished by actuating the branch damper(s). Now a word of caution to both the designer and the testing and balancing engineer as to how important sufficiently and accurately placed volume dampers are to the overall performance and ease of operation of an air handling system.
6. Recheck the percentage in item 4 and if less than 1, adjust all other outlets (on the same branch) to the same ratio.
7. Recheck the base outlet again, and adjust if necessary to closer required ratio.
8. Adjust the other branches so that their capacities agree with the remote branch (handled previously) in relation to the design conditions. Then recheck the remote branch to see if its quantity has been modified.
9. After all of the branches are of the same relative ratio to design figures, increase fan capacity, if necessary, to bring all units up to design quantities.

If the system involves many sub-mains, each sub-main should be treated as an outlet, and by the same

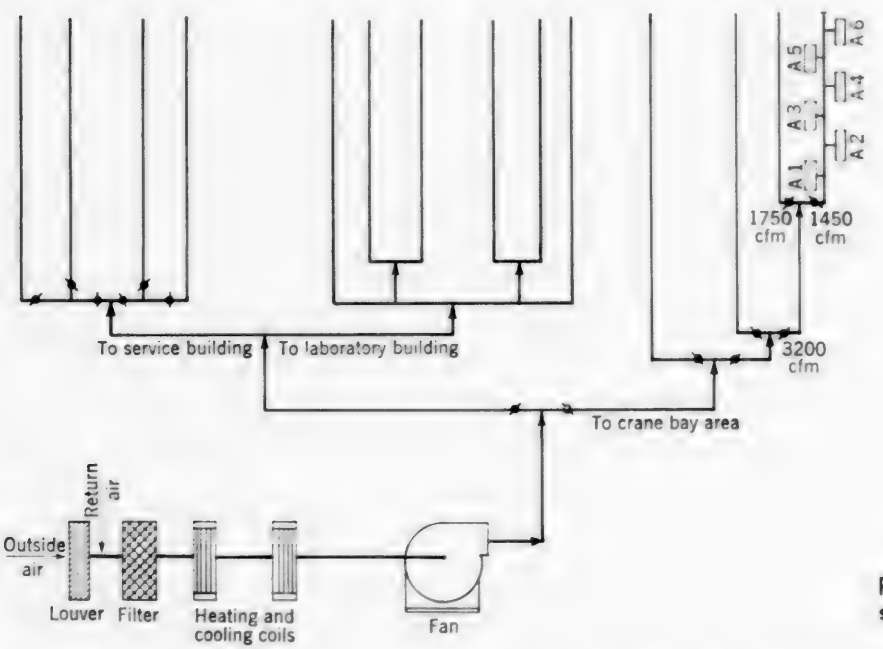

Fig. 2. Layout of an air delivery system, with arrangement of outlets in a crane bay area.

9 steps, the capacity adjusted before handling each individual branch and outlet.

After total air quantity adjustments have been completed, a final spot check should be made of several random outlets, plus the base outlet on each branch, to insure a satisfied balance has been accomplished. The base outlet may be any one of the outlets of the branch, but usually the most generally accepted one, is that one having the least cfm.

In establishing air quantities, a tolerance of ± 5%, either in individual outlet or total air quantity of system, may be considered satisfactory since the element of human error in the manipulation of readings may readily account for a difference of this magnitude.

Example of Balancing

To illustrate the balancing of a system, refer to Fig. 2. It is the duct system to a crane bay area, as the least favored line. The recommended system of balancing is as follows:

1. Open all dampers, inspect equipment and start fans as previously described.
2. Compile a table (or tables) for the entire system, one for each main, sub-main, or branch (whichever is more convenient and, of course, depending on the size of the installation).

When all of the dampers are in the open position to ascertain the actual air volumes, all adjustments must be in the modulating stage. Therefore, while the damper of the least favored outlet (or base) shall be retained fully open, all other dampers of outlets shall be manipulated to achieve the allotted total air quantities for all the remaining outlets, according to design requirements.

A re-check of the base outlet should be made, and if the reading is not the required design quantity, then readjust the fan delivery. All other outlets on the same branch will be, therefore, corrected since they are in required corresponding ratio to the base outlet.

A final check of approximately one in every six outlets will confirm that the system is acceptably balanced.

Past experience has shown that, even with the help of competent personnel, more than a few days are required on most systems to achieve good balancing.

Some large complicated systems have taken over 100 man-days.

Of course, there are also systems in operation (not satisfactorily) that have never been balanced and never will be, because insufficient or no funds were allocated for this procedure. The result is that because of operating results, these systems are considered of poor design, although with most of the installations, this is not so. The missing link is the proper balancing of the system.

Piping for Heating Coils in Air Conditioning Units

The air conditioner unit often has a heating coil which must be supplied with steam and, therefore, some attention must be given to the steam piping. According to Worthington Corporation, the steam heating coil will only provide the rated capacity if attention is paid to some basic considerations.

It is important that the rate of air flow and the air entering temperature should be in accordance with the basis on which the coil was selected.

The steam should have little or no superheat. It might be thought that superheated steam, because of its higher temperature at a particular pressure, would increase the coil capacity. Attention was called to the fact that this is not the case for although the initial temperature is greater, the convection heat transfer rate of the steam being desuperheated is far less than the condensing steam transfer rate on which the coil capacity was based.

The coil must be free of air and in practically all cases, air venting should be handled by a thermostatic vent or trap. The connection to this is taken from a suitable point in the return line between the coil and the float trap. In some cases, the air can be discharged directly to the atmosphere; in others, the thermostatic vent or trap should discharge to a dry return so that the final discharge is at a central point and possibly through a vacuum pump.

A single thermostatic vent should not be used for venting two or more coil outlets, for if the venting of air from one is more rapid so that steam reaches the end before the venting of another is complete, the trap will be held closed and venting of the other coil or coils will be stopped.

The steam pressure at the coil should be at least as great as that on which the selection was based. The pressure at the steam boiler or in the steam main is not an indication of the pressure at the entrance to the coil header, after manual and automatic valves, fittings, and other pipe friction factors.

When air at temperatures below freezing is to pass over the coil, a non-freeze type coil should be used unless the steam supply is such as to fully heat the coil, or plans are made to shut off the coil when the air is below the freezing point. However, a non-freezing type coil can freeze if the modulation reduces the steam supply to a very low rate or if the condensate does not drain well.

A vacuum breaker becomes necessary if the system is not a relatively high vacuum type and a vacuum is permitted to exist in the coil.

It is important that the coil be well drained of condensate. Any restriction that keeps the water from freely draining, makes part of the coil surface ineffective.

Selecting Air Conditioning Systems for Specific Applications

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Tables prepared on the evaluation of systems according to (a) functions performed by the systems and (b) the type of application are used to select a system that shows the best economy for a specific application.

ENGINEERS are called upon to recommend the type of air conditioning economically suitable for a specific application. In reality, they are called upon to determine the type of system which will provide the greatest benefits per dollar of overall cost. It is desirable therefore, that there should be an understanding of the functional performance of the many different types of systems and the relative importance of certain factors on our comfort.

For assistance when evaluating the requirements of certain applications such as motels, offices and schools, see Tables 1 to 4. The ratings indicate the potential capacity of various systems to maintain within required limits, those factors which contribute to a desirable atmospheric environment.

These numerical rating methods for systems and for various applications represent the consensus of 11 individuals whose combined experience in development, application and sales of air conditioning total approximately 200 years. This simplified method may be of value. It does establish within practical limits, the differences in performance of the many different systems available and should provide a basis for qualifying the end result.

Table 1 shows the relative functional capacity of different systems. It assumes the present day design criteria associated with such systems. For example, central air treating assemblies for systems 1, 2, 3, 4, 7, 8, 9, usually provide more effective air cleaning and humidification. Room dry bulb is usually con-

TABLE 1—FUNCTIONAL EVALUATION OF SYSTEMS

System No.	System Type	System	Temp.	Air Quality			Noise Cont.	Air Motion	Rel. Hum.
				Cleaning	Odor Removal	Germicidal Treatment			
			A	B	C	D	E	F	G
1		All-air cooling with reheat	9.0	9.0	9.0	9.0	9.0	9.0	9.0
2		Double duct	9.0	9.0	9.0	9.0	7.0	9.0	8.0
3		Single duct variable volume	5.0	8.0	7.0	7.0	6.0	6.0	6.0
4	ALL-AIR	Dual conduit	9.0	9.0	8.0	9.0	8.0	8.0	7.0
5		Package equipment	6.0	7.0	5.0	6.0	6.0	7.0	5.0
5A		Package equipment (with reheat)	8.0	7.0	5.0	6.0	6.0	7.0	5.0
6		Package heat pump	8.0	2.0	4.0	6.0	6.0	7.0	5.0
6A		Package heat pump (with reheat)	9.0	7.0	4.0	6.0	6.0	7.0	5.0
7	AIR-	Induction	8.0	6.0	4.0	6.0	9.0	8.0	7.0
8	WATER	Radiant panel	7.0	5.0	5.0	7.0	9.0	5.0	8.0
9		Fan coil with primary air	8.0	7.0	4.0	6.0	6.0	8.0	7.0
10	ALL-	Fan coil with outside air	6.0	5.0	4.0	3.0	6.0	7.0	4.0
11	WATER	Fan coil — No air	5.0	6.0	2.0	3.0	7.0	8.0	4.0
12		Self contained heating and cooling units	7.0	4.0	3.0	3.0	5.0	7.0	4.0
13	REFRIG-ERANT	Self contained heat pumps	8.0	4.0	3.0	3.0	4.0	7.0	4.0
14		Self contained cooling units with baseboard radiation	7.0	4.0	3.0	3.0	5.0	7.0	4.0

TABLE 2—FUNCTIONAL REQUIREMENT OF SPECIFIC APPLICATIONS

(Relative effect of various functions on comfort)

Application	Col. A	Col. B	Col. C	Col. D	Col. E	Col. F	Col. G
	Temperature	Air Quality			Noise Contribution	Air Motion	Relative Humidity
		Cleaning	Odor Removal	Germicidal Treatment			
Commercial offices	8.5	7.0	7.5	5.5	6.5	7.0	3.0
Apartments	9.0	7.5	8.0	5.5	8.0	5.5	4.5
School classrooms	9.0	7.0	9.0	8.5	8.5	7.5	7.0
Motels	8.5	6.5	7.5	5.0	8.0	6.0	3.0
Hospital patient rooms	9.0	8.0	8.0	9.0	8.5	7.5	7.5
Factory comfort cooling	6.0	4.0	3.5	3.0	2.0	4.5	1.5
Computer rooms	8.0	8.0	4.0	3.0	4.5	4.0	6.0
Medical buildings	8.5	8.0	9.0	9.0	6.5	6.0	5.0
Hotel guest rooms	7.5	6.5	7.5	5.0	8.5	6.0	5.0
Bowling alleys	6.5	4.0	6.0	4.0	2.0	3.5	3.5
Churches	7.0	4.0	5.0	5.5	7.0	5.5	4.0
Auditoriums	7.0	4.0	7.0	5.5	7.0	5.0	4.0
Food stores	8.0	3.0	4.0	3.0	2.0	4.0	4.0

trolled by a modulating device. Conversely, systems 10, 11, 12, 13, 14, may use "on-off" control of the fan for sensible capacity control. Generally speaking, air cleaning devices are not too effective nor is humidification incorporated. The noise contribution is usually higher than that encountered with other types.

These evaluations also recognize the advent of a more practical and efficient means for odor absorption and germicidal treatment.

The numerical rating assumes that 10 represents the best or ideal. On the other hand, a rating of 1 or zero would indicate poor or complete lack of control of this function. As an example, most systems will maintain the dry bulb within acceptable limits; however, those with "off-on" control, or where the required potential heating capacity is controlled at a central point, will not provide a year-round acceptable temperature. It is evident that none achieve the ideal in this respect. Also, maintenance of humidity, if essential, is not possible with some systems especially during the humidification period.

The need for close control of these different factors varies with the type of application. Table 2 shows the relative importance on our comfort of these functions. It is generally accepted that the dry bulb temperature has the greatest effect on comfort, regardless of the application. This is evident from the rating assigned by the panel members. It should be noted, however, that odor removal and germicidal treatment were given equal importance for certain applications.

The system functional evaluation ratings, Table 1, and the relative importance of these factors on our comfort according to application as shown in Table 2 should provide a means for determining the proper system for a particular application, assuming of course that the overall economics is not the influencing factor. It will provide a basis for recommendation as to type.

The selection of the one system, from those under consideration for any particular application is shown

TABLE 3—SYSTEM SELECTION FOR A MOTEL

(Functional Aspects only and Regardless of Economics)

Function of System	System 10			System 12			System 13			System 14		
	Fan Coil with Outside Air			Self-Contained Heating and Cooling Unit			Self-Contained Heat Pump			Self-Contained Cooling Unit with Baseboard Heating		
	W	F	T	W	F	T	W	F	T	W	F	T
A—Temperature	8.5	6.0	51.0	8.5	7.0	59.5	8.5	8.0	68.0	8.5	7.0	59.5
B—Cleaning	6.5	5.0	32.5	6.5	4.0	26.0	6.5	4.0	26.0	6.5	4.0	26.0
C—Odor Removal	7.5	4.0	30.0	7.5	3.0	22.5	7.5	3.0	22.5	7.5	3.0	22.5
D—Germicidal Treatment	5.0	3.0	15.0	5.0	3.0	15.0	5.0	3.0	15.0	5.0	3.0	15.0
E—Noise	8.0	6.0	48.0	8.0	5.0	40.0	8.0	4.0	32.0	8.0	5.0	40.0
F—Air Motion	6.0	7.0	42.0	6.0	7.0	42.0	6.0	7.0	42.0	6.0	7.0	42.0
G—Relative Humidity	3.0	4.0	12.0	3.0	4.0	12.0	3.0	4.0	12.0	3.0	4.0	12.0
Total			230.5			217.0			217.5			217.0

TABLE 4—SCHOOL CLASSROOM

Function of System	System 1 All-Air Cooling with Room Reheat			System 2 All-Air Double Duct			System 6 Package Type Heat Pump			System 10 Room Fan Coil with Outside Air		
	W	F	T	W	F	T	W	F	T	W	F	T
A—Temperature	9.0	9.0	81.0	9.0	9.0	81.0	9.0	8.0	72.0	9.0	6.0	54.0
B—Cleaning	7.0	9.0	63.0	7.0	9.0	63.0	7.0	7.0	49.0	7.0	5.0	35.0
C—Odor Removal	9.0	9.0	81.0	9.0	9.0	81.0	9.0	4.0	36.0	9.0	4.0	36.0
D—Germicidal Treatment	8.5	9.0	76.5	8.5	9.0	76.5	8.5	6.0	51.0	8.5	3.0	25.5
E—Noise	8.5	9.0	76.5	8.5	7.0	59.5	8.5	6.0	51.0	8.5	6.0	51.0
F—Air Motion	7.5	9.0	67.5	7.5	9.0	67.5	7.5	7.0	52.5	7.5	7.0	52.5
G—Relative Humidity	7.0	9.0	63.0	7.0	8.0	56.0	7.0	5.0	35.0	7.0	4.0	28.0
Total			508.5			484.5			346.5			282.0

in Table 3. Assume that a motel project is in the planning stage and recommendations are in order as to the best type of air conditioning. Perhaps different manufacturers or different contractors are proposing three or four different approaches to the problem. Assume that systems comparable to 10 (fan coil with outside air), 12 (self contained heating and cooling unit), 13 (self contained heat pump) and 14 (self contained cooling with baseboard heating) are proposed. The performance ratings for the various systems are entered in column *F* of Table 3 for each of the various functions. The numbers indicating the relative importance of these functions for the particular application are entered in Column *W*. Please examine the product of these two as listed in Column *T*. The total of entries in this column gives the evaluation figure for the system. It indicates the best of these systems analyzed for the application. This is a functional appraisal and since there is no significant difference in the overall rating, then the economics would determine the selection of a system.

As another example, assume that the application is a school classroom and that systems 1, 2, 6 and 10 are under consideration. Tabulation of system performance and application requirements are shown in Table 4. There is a significant difference in the functional aspects of these four systems, a fact which is well known. It indicates that we should promote the all-air type systems if we are interested in providing an acceptable "climate for learning".

The overall economics will oftentimes affect the selection of the system in this particular market; however, when owning and operating costs have been established and related to benefits, it should not be too difficult to show, when all points have been considered, the merit of system 1.

India Studies Use of Solar Energy for Cooling

The possibilities of the use of solar energy in conjunction with various systems for the dehydration and cooling of air is being explored in India, according to an article by J. C. Kapur in Solar Engineering. Although a number of experimental investigations were made, the manufacture of commercial units is still in very preliminary stages.

Unlike other countries, India in many areas is without traditional sources of power and there is very little hope of any appreciable power development in the foreseeable future. India is determined to widen her industrial dimension and to increase productivity by making temperatures of working areas more favorable to a greater production output. The most important deterrent to the use of accepted methods of climate control for purposes of process control and for main taining a high level of productivity, are the power and maintenance expenses. The utilization of solar energy, therefore assumes considerable importance.

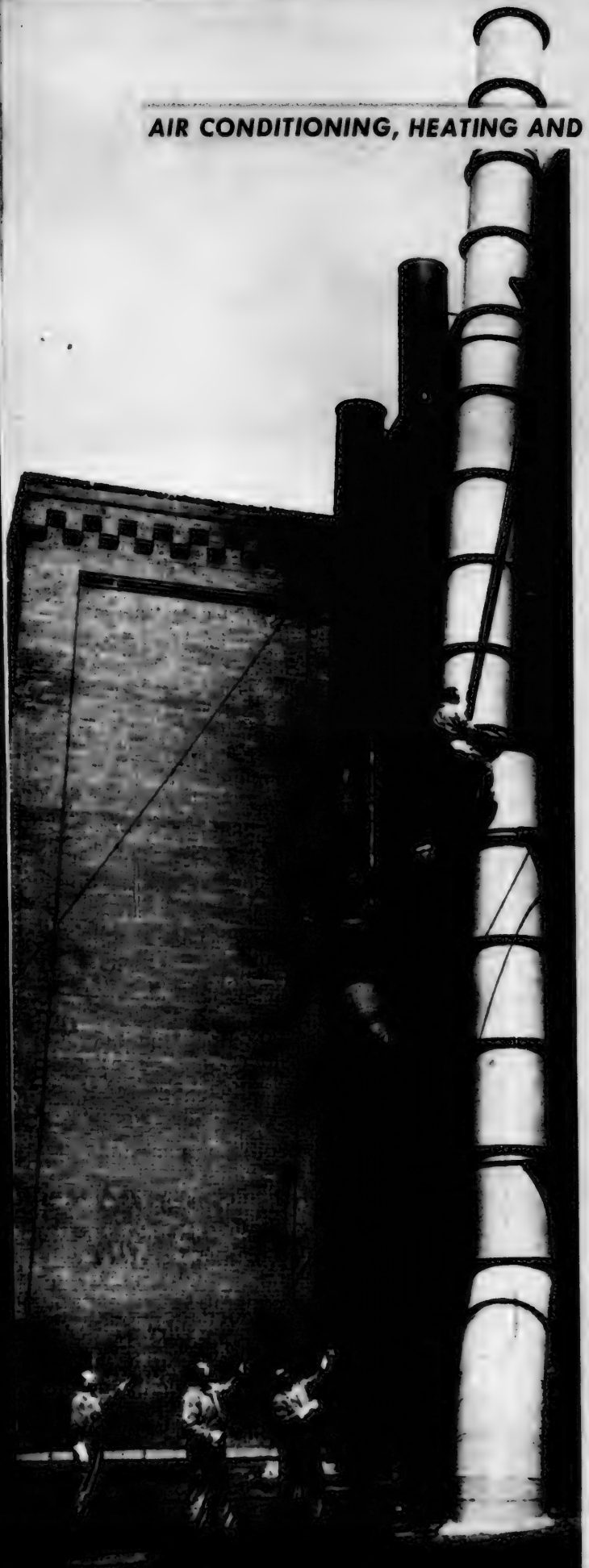
There is an extensive incidence of solar radiation in most parts of India throughout the year. An important factor in space cooling with solar energy is the availability of maximum solar radiation where cooling is most needed.

In view of these and other factors, it is believed that widespread benefits can accrue from an organized effort in the sphere of space cooling and storage refrigeration with solar energy.

A system using absorption or adsorption methods of dehumidification with chemical desiccants shows considerable promise, particularly where it is used in conjunction with sensible cooling in a heat exchanger. In the final stage, the air is evaporatively cooled in a controlled manner.

In New Delhi, for example, during the summer months of March to September, it would be possible for 58% of the time to maintain reasonable conditions when solar radiation is not available.

Except for the rainy or cloudy days, during the remaining period, comfort or close to comfort conditions can be obtained for almost 90% of the total time.



PLASTIC VENTILATION PRODUCTS

HAROLD M. ENGLUND
Associate Editor

The types and uses of plastic pipe have been the subject of a good deal of literature during the past few years and are quite well known. Not so familiar, however, are the various types and uses of plastics in corrosive exhaust installations. Here is an introduction to these plastic ventilation products and their varied industrial applications.

Fig. 1. Polyvinyl chloride duct system vents corrosive acid fumes that develop during plating operations at Zippo Manufacturing Co. Photo, A. M. Byers Co., Pittsburgh, Pa.

JUST AS PLASTIC PIPE enjoys advantages in certain applications over metal pipe, so plastic materials have their proper place in certain ventilating applications, such as exhausting corrosive industrial fumes or withstanding external attack in a corrosive atmosphere.

Thermoplastics are described as plastics which soften upon application of heat and reharden upon cooling. They can be softened and hardened repeatedly without any change in the properties of the material.

This is not the case, however, for thermosetting materials which, while they also come under the general term of plastics, behave quite differently from thermoplastics. Thermosetting materials, upon heating, become chemically cross-linked and infusible; as a result, they cannot be softened by moderate re-heating, although if heating becomes excessive, they undergo chemical decomposition and degradation.

While thermosetting plastics do not have wide use in piping applications, they do share the corrosive exhaust field with thermoplastics. After describing the general use of plastics in this application, this article will then attempt to define the limits of each type, with respect to corrosion resistance, cost, availability of fabricated and unfabricated parts, and field-fabrication, installation and maintenance techniques.

General Use of Plastics

Previously, the main use of plastics in chemical service in this country had been limited to their use as protective coatings, of more or less permanent nature, and later as heavier coatings and sheet linings, for inside and outside protection. Now, however, there is a gradually increasing use of self-supporting plastic structures in ducts, hoods and stacks. Here are some reasons for this change:

1. The accessibility of duct sections for application of coatings and linings presented considerable problems. The use of dipping and improved spraying methods has overcome some of these problems, but has created other problems of a primarily chemical nature.

2. Plastic duct work is not subject to the phenomenon of vapor transmission which contributes to loosening of certain types of coatings and linings.

3. Solid plastic duct work has generally a wider range of chemical resistance than the same types of material applied in the form of coatings and linings.

4. Inside and outside surfaces are equally resistant to chemical exposure and a minimum of maintenance is assured.

5. Some of the newer materials and material combinations lend themselves handily to use as structural materials with excellent chemical resistance.

The relative newness of these plastic materials has hindered their acceptance. The scarcity of past performance data and engineering design data resulted in considerable reluctance on the part of design and corrosion engineers to incorporate plastics in their plans for a particular project. An acceptable plastic was quite frequently by-passed for an alloy or other structural material with a known past performance.

The importance of plastics as structural materials for ducts and stacks lies not so much in their ability to compete with other materials of construction—both economically and technically—but in their ability to cope with the many new conditions which the vast number of chemical processes have brought about.

THERMOPLASTICS

The principal thermoplastics used for ventilating applications are the following:

1. Rigid polyvinyl chloride
2. Polyethylene
3. Polypropylene

Polyvinyl Chloride

Rigid, or unplasticized, polyvinyl chloride is the predominant material in this group. The position occupied by this material is probably due to a combination of advantageous properties, including high strength, wide range of corrosion resistance, and ability to be fabricated and joined to itself by a variety of fabrication processes which are quite similar to the methods employed with sheet metal.

Besides being produced in various forms, PVC is now fabricated by a large number of companies on a commercial basis, and actively competes with other standard materials of construction. Much has been learned in the past few years regarding improved fabrication methods, as well as methods of installation and support. The increasing amount of performance data, in combination with chemical exposure tests to determine long-term effects on strength and stiffness, is now furnishing quite a sound basis for material consideration and application.

Also, the increasing availability in polyvinyl chloride of standard equipment allied to ducts, stacks and hoods such as exhaust fans and fume scrubbers has widened the field of application, since it can offer the desirable "package" system. Polyvinyl chloride is generally available in two basic types. Type I (normal impact) is completely unplasticized and unmodified PVC. (Subtle gradations are sometimes available in this type, as well as in some of the thermosetting plastics. This article will deal only with basic types; manufacturers should be consulted for sub-types consisting of slight variations in composition, pigmentation, etc.). Type II (high impact) is modified, unplasticized PVC. The modification consists of the addition of rubber-like materials which bring about an increase in impact strength, while the chemical resistance, tensile strength and upper-heat limit are somewhat reduced.

PVC is produced in the following semi-finished forms from which various end products, for ventilating and other applications, can be fabricated:

Plate, ranging from 1/16 to 2-inch thickness;
Joining accessories, such as welding rod, joining strip and angle, and solvent welding cement;
Extrusions, such as angle, rods, bars; and
Bolts and nuts, ranging in length from ½ to 6 inches, and in diameter-thread specifications from ¼-20 to ¾-10

REFERENCE SECTION

PVC is also offered by many companies in a wide range of standard and special sizes and forms for ventilating and exhaust applications. These include:

Round fume duct and fittings in sizes from 4 to 36 inches diameter;
Rectangular fume duct and fittings in almost any size or cross-section;
Weather caps and butterfly dampers; and
Fume hoods in any hood design capable of being fabricated from sheet metal.

Corrosion Resistance

Polyvinyl chloride is resistant to chemical attack by an extremely wide range of corrosive agents which destroy other construction materials. In general, its resistance to acids is excellent, extending even to strong oxidizing acids in high concentrations. Resistance to attack by alkalies and alkaline salts is very good. Although certain organic compounds such as acetone, aromatic hydrocarbons, chlorinated compounds, ethers, esthers and ketones exhibit a solvent or swelling effect (absorption and subsequent swelling is a characteristic of thermoplastic corrosion), there are many others in regular use for which PVC is completely satisfactory. These include vegetable and animal oils, aliphatic hydrocarbons and most alcohols.

Fabrication in the Field

Rigid polyvinyl chloride can be machined, sawed, cut, drilled, punched, and also formed and bent like most metals. Joining to itself is possible by hot-air (fusion) welding, solvent-welding (cementing), and by use of PVC bolts and nuts. The choice of fabrication methods and their combination make possible the com-

Fig. 2. This polyvinyl chloride duct system was fabricated rapidly through use of PVC joining strips which eliminate bending, minimize hot-air welding. Photo, The Colonial Plastics Mfg. Co., Cleveland, Ohio.

mercial fabrication of both custom as well as mass-volume products on a very economical basis, plus easy field-fabrication in the shop of an industrial contractor or plant.

All machining, drilling and cutting operations are carried out on standard tools used for metals or wood, generally at machining speeds comparative to those used with aluminum. No special precautions are required other than the recommended machining speeds be observed. It is also advisable to use alloy steel or carbide tipped tools and saws since rigid PVC, when overheated during machining, will liberate minute amounts of hydrochloric acid due to thermal decomposition which corrodes mild steel and destroys cutting edges.

Rigid polyvinyl chloride, which is completely rigid at room temperature, changes at about 175 deg F from rigid to a rubbery, highly elastic state. From this point up to about 270 deg, it is possible to form various semi-finished sections, and to maintain the obtained form by cooling below the softening point of 175 deg. This applies to bending of plate, for rectangular sections, as well as to rolling of cylindrical sections for round ductwork. Equipment for bending and rolling is extremely simple to erect, and is generally adapted from available metal forming equipment. Only sources for local as well as complete application of heat must be provided for bending or rolling, respectively, of rigid PVC plate.

Joining Methods

Rigid PVC can be joined to itself by the widest range of joining methods for structural materials. These are:

Solvent Welding. PVC can be solvent welded by application of solvent cement to the surfaces to be joined. The joint has to be kept under moderate pressure for a short period to allow evaporation of excess solvent.

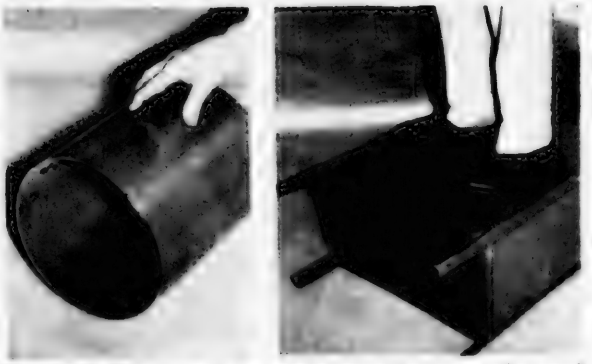


Fig. 3. PVC joining strips are adaptable to round as well as rectangular duct sections. Photo on right illustrates structural strength of 1/8-inch PVC plate, which is permitted through this type of fabrication. Photos, Kaykor Industries, Inc., Yardville, N. J.

This joining method results in structural joints of high strength and is limited only by the practicality of its use, which may require considerable jigging and aligning.

Hot-Air Welding. The hot-air welding process is probably the most important joining method for rigid polyvinyl chloride. It is similar to the oxy-acetylene welding process, except that it is flameless and a hot-air stream constitutes the source of heat. The welding process is carried out at temperatures ranging from 335 to 400 deg, and takes place only on the surface of the base material and the welding filler rod. The filler rod is fused onto the joint to be welded by the heat from the welding gun and moderate pressure exerted by the operator's hand.

In designing, welds should be located to permit use of butt welds, although corner and fillet welds, when necessary, can be used. It is advantageous to use butt welds to allow for easier jigging and for better welding technique. An experienced welder will average 80% to 90% of the strength of the base material.

Joining Strips. Great time and labor savers in the fabrication of ducts, stacks, hoods, and other similar structures are 90-degree and H-type joining strips

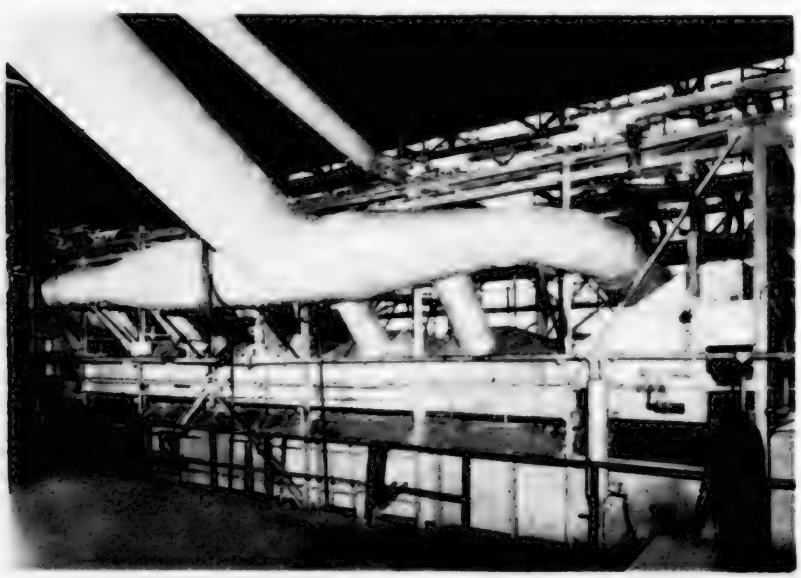


Fig. 4. High temperature exhaust fumes from sulfuric acid pickling tanks are handled here by round duct system made of polyester resin, glass-fiber reinforced. Photo, Heil Process Equipment Corp., Cleveland, Ohio

made of PVC. Instead of producing fabrications through bending and hot-air welding, even inexperienced personnel can quickly and easily accomplish a wide range of fabrications by utilizing the H-type joining strip to produce a joint between two pieces of PVC plate in the same plane, and the 90-degree joining strip to make a sound corner joint with a reinforcing and stiffening member on both the inside and outside. This joint is sealed by the use of solvent cement or by back-welding the lap seal with welding filler rod, or both. The fit of the slot and the sheet will permit continuous fabrication.

In general, both rectangular and circular ducts are made with 3/16-inch PVC plate, although manufacturers of the joining strips report that these strips permit use of ⅛-inch material since no bending or rolling is required and therefore no reduction in plate thickness will take place.

Figures 2 and 3 illustrate the application of these joining strips. Figure 2 shows a PVC duct system which was fabricated by means of the joining strips, and Fig. 3 presents both round and rectangular duct sections made through this technique.

PVC Nuts and Bolts. Rigid PVC nuts and bolts are used in the conventional manner, except that the comparatively low shear strength of this material must be taken into account to avoid shearing off bolt heads due to excessive tightening.

Installation

Round or rectangular duct, up to 12 inches in diameter or 12 inches square, must be supported every

TABLE I — ACTUAL INDUSTRIAL INSTALLATIONS OF THERMOPLASTICS AND THERMOSETTING PLASTICS FOR CORROSIVE EXHAUST

Company	Location	Type of Industry	Exhaust Gases		Type of Plastic
			Type and Source	Temperature, Deg F	
Dow Chemical	Freeport, Tex.	Chemical	Cl_2 gas	190	Phenolic, asbestos-reinforced
Westvaco Chemical	South Charleston, W. Va.	Chemical	Cl_2 gas	200	Phenolic, asbestos-reinforced
Diamond Alkali	Painesville, Ohio	Chemical	Cl_2 gas	200	Phenolic, asbestos-reinforced
Noranda Mines	Niagara Falls, Can.	Metallurgical	Roasting gases	350	Phenolic, asbestos-reinforced
Molybdenum Corp.	Washington, Pa.	Metallurgical	Exhaust gases	200	Phenolic, asbestos-reinforced
DuPont Co.	Brevard, N. C.	Chemical	HCl vapors	190	Polyester, glass-fiber reinforced
Monsanto Chemical	Anniston, Ala.	Chemical	Exhaust gases	150	Polyester, glass-fiber reinforced
International Paper Co.	Natchez, Miss.	Paper	ClO_2 exhaust	Ambient	Polyester, glass-fiber reinforced
Women's Medical College	Philadelphia, Pa.	College research lab	Exhaust gases	Ambient	Polyester, glass-fiber reinforced
DuPont Co.	Wilmington, Del.	Chemical research lab	Exhaust gases, lab hoods	Ambient	Polyvinyl Chloride
Owens-Corning Fiberglas Co.	Barrington, N. J.	Glass	Exhaust gases, lab hoods	Ambient	Polyvinyl Chloride
J. Bishop & Co.	Malvern, Pa.	Metallurgical	Aqua regia, vapors system	150	Polyvinyl Chloride
Eli Lilly Co.	Lafayette, Ind.	Drug	Fume system	180	Furanes
Parke-Davis Co.	Holland, Mich.	Drug	Fume system	200	Furanes
Geigy Chemical	Cranston, R. I.	Drug	Exhaust gases	150	Epoxy, glass-fiber reinforced
Zippo Mfg. Co.	Bradford, Pa.	Manufacturing	Acid fumes, chromic, sulfuric and hydrofluoric plating tanks	—	Polyvinyl Chloride

five feet. Larger duct, up to 30 inches, must be supported every three feet. Duct over 30 inches in diameter requires support at least every two feet.

Horizontal runs of round duct may be suspended from overhead pipe hangers attached to light steel bands clamped around the duct.

Rectangular duct is supported on light steel angles placed either across the bottom of the duct, or lengthwise along the bottom edges.

Duct work should not be installed near steam lines, heaters or other equipment which will raise the temperature of the ambient air above 150 deg F.

Polyethylene

The use of polyethylene in duct systems has increased but still is somewhat limited, primarily due to relatively low strength which makes supporting more complex and costly. Duct work use is generally limited to small diameter sections which can be provided economically in round, centrifugally cast sections.

One manufacturer of high-density polyethylene extruded rolls and sheets offers a standard roll width of 48 inches in 10 or 15-inch diameter rolls on a 3-inch core, plus standard sheets trimmed to 48 by 96 inches. The company states that the chemical resistance of this material is excellent; it is not attacked by acids or alkalies. It is also reported to have good resistance to cracking under stress in chemical environments.

Sheets of this material can be worked with common wood working or machine tools if the usual precautions taken with any thermoplastic are observed. It is stated that staples, self-tapping screws and nails may be used with satisfaction, and welding can be accomplished by using round filler rods of the identical formulation as composes the part to be welded. No solvent welding technique is possible with polyethylene.

Polypropylene

The introduction of polypropylene promises to offer vastly improved strength and heat-distortion properties, as well as resistance against solvents and highly oxidizing materials. It may ultimately prove to be the most versatile thermoplastic material of construction, provided that these promised properties can be realized in sheet and structural form. Also, certain problems regarding the joining of sections, as well as their forming, and the question of stress-cracking must be solved adequately.

Other Thermoplastics

The use of fluorocarbon polymers as structural materials has been quite limited, primarily because of their present exceedingly high cost, as well as the lack of fabrication techniques using solid sheet as structural sections. However, in terms of their almost absolute inertness against most all corrosive vapors and condensates, fluorocarbon polymers are theoretically the ideal material of construction.

New to the thermoplastic structural material field are the chlorinated polyethers and the recently-announced polyvinyl dichloride. Insufficient long-term experience with these materials makes a true evaluation difficult at the present time.

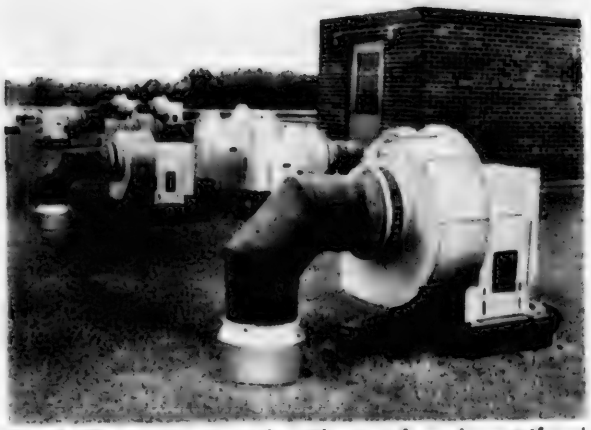


Fig. 5. These polyester, glass-fiber reinforced, centrifugal fans exhaust fumes from the laboratory hoods of a midwestern chemical manufacturer. Capacities range from 1000 to 3400 cfm, depending on size of each hood. Photo, Heil Process Equipment Corp., Cleveland, Ohio.

THERMOSETTING PLASTICS

Among the thermosetting materials used for corrosive exhaust equipment, the following must be included:

1. Furan Resins (asbestos-fiber or glass-fiber reinforced)
2. Phenolic Resins (asbestos-fiber reinforced)
3. Polyester Resins (glass-fiber or synthetic-fiber reinforced)
4. Epoxy Resins (glass-fiber or synthetic-fiber reinforced)

Phenolic and Furan Resins

Phenolic and furan resins with specially selected and processed, chemically-inert reinforcing agents have enjoyed extensive use in various types of chemical process equipment, including exhaust equipment carrying corrosive vapors and fumes, longer than any other type of plastic material. While the production of various units still requires molds and forms, it can be achieved with light and relatively inexpensive molds, permitting the production of large equipment molded in single pieces at low cost. While this type of material may not be as broad and universal in its chemical resistance range as some of the important thermoplastic materials mentioned, it does lend itself to specialized compounding to counter specific conditions. Furthermore, these phenolic and furan type compounds are relatively insensitive to thermal shock and offer a wider temperature operating range than most other plastic materials, namely up to about 300 deg.

Asbestos-reinforced phenolic resins boast excellent resistance to most solvents, salts and acids, especially hot hydrochloric acid, sulfuric acid, sulfur di- and tri-oxide. They are not recommended for use with oxidizing agents, strong bases like sodium hydroxide or fluorine compounds.

Asbestos-reinforced and glass-fiber reinforced furan resins are reported to have excellent resistance to most

alkalies, solvents, acids and salts, including hot concentrated sodium and potassium hydroxide solutions and chlorinated aromatic compounds. They are not recommended for use with strong oxidizing agents.

While the manufacture of custom-built sections and systems may be affected by the cost of special molds and forms, there are now available a large number of standard duct sections in various diameters and lengths, as well as duct fittings, dampers, axial and centrifugal fans, and other integral parts of exhaust systems.

Polyester Resins

In recent years, glass-reinforced polyester resins have made the greatest advances in the thermosetting plastics group as far as their use in chemical resistant exhaust systems are concerned. Here, again, by proper compounding, construction materials of optimum chemical resistance and thermal properties can be obtained. Much has been learned about the form and arrangement of the glass filaments which influence the physical properties of the exhaust equipment and also determine the fabrication techniques to provide these end products. Much has also been learned about proper surface treatment of the glass filaments to assure bonding of resins used, which also affects both the physical and chemical resistance of the product.

There have been recent advances in the quality of resins used in the manufacture of glass-reinforced polyester structures, primarily with regard to their resistance against alkalies and their general outdoor-aging properties. New techniques are becoming more generally used, and in order to overcome certain deficiencies, such as the poor resistance of glass against hydrofluoric acid, manufacturers are now resorting to various synthetic fibers and filaments, such as woven Dynel fabric, to replace glass as a reinforcing medium. A very recent improvement is the use of special mechanically-interlocked felts, composed of synthetic fibers, which offer exceptional chemical stability, especially under wet or high-humidity conditions where some of the conventional polyester formulations in duct work where encountering chemical difficulties.

Polyester glass equipment permits continuous use at temperatures up to 212 deg, and intermittent use as high as 265 deg. It shows excellent resistance to acid attack, including oxidizing media, and it affords broad resistance to solvents, particularly at low to moderate temperatures.

Polyester glass exhaust equipment, as well as the other reinforced, thermosetting plastics, is generally factory-fabricated in a variety of standard and special forms and sizes. Field work with these plastics is generally limited to the assembly of factory-fabricated sections and to the repair or alteration of these sections, should this become necessary. Field assembly, such as the jointing of lengths of duct or of duct fittings and hoods, and repair-alteration are generally accomplished by means of kits which provide a joint with the identical chemical characteristics of the particular exhaust equipment. These kits consist of fiber glass reinforcement mats, can of resin, catalyst, and simple application tools. Figure 6 shows the

Fig. 6. These photos show the field jointing procedure for reinforced plastics. Kits provide all materials. Curing time is about two hours.

Roughen areas to be joined.

Brush resin on glass mat.

Place mat on joint. Apply more resin.

Place wider mat over first and smooth.

Jointing procedure for round duct.

procedure that, if followed, permits even an untrained individual to produce a sound, homogenous joint.

It should be noted here that lack of field-fabrication techniques is not a particular disadvantage for any plastic material so long as a wide range of sizes and styles is available in pre-fabricated form.

Epoxy Resins

The use of glass-reinforced epoxy resin in chemical exhaust equipment has been rather limited, although its strength and resistance against certain oxidizing conditions may be of great interest to several selected industries. Temperature limit is about 300 deg.

WHICH ONE TO USE?

The next logical question is: "Which plastic material will best suit a given exhaust application?" If this article is to have any significance other than just a presentation of a group of plastic materials and their characteristics, it must provide some guide to the proper selection and application of these materials.

There are two rational approaches to this problem. One is to examine a list, such as Table 1, of various exhaust installations actually using these structural plastics. Assuming that these jobs were properly engineered, with regard to type of chemical exhaust, temperature, strength and economics, such a listing can be a useful guide to proposed installations with similar requirements.

The other approach is to examine specific recommendations for the use of various thermoplastics and thermosetting plastics in chemical exhaust service. Before going to these specific recommendations, however, let's take a look at Fig. 7.

This diagram graphically portrays, for the purpose of better understanding, the relative field of service for thermoplastics and thermosetting plastics. The horizontal extremes signify lower temperature, highly corrosive service, and this area generally belongs to the thermoplastics. The top extreme signifies higher temperature, medium corrosive service, and this area is suited by the high temperature strength of the reinforced plastics. The colored area is the corrosive and temperature range where both thermoplastics and thermosetting plastics are suitable, and selection is properly made here on the basis of cost, strength, appropriateness of field fabrication as opposed to pre-fabrication, etc.

The high temperature, highly corrosive areas at top right and left are described as being strictly academic, and the present lack of any suitable materials is not of too much importance.

For more specific guidance than the foregoing, Table 2 presents the relative chemical resistance to acids, alkalies, and organic solvents of various thermoplastics and reinforced plastics; Table 3 lists average physical properties for some of these plastics.

Procedure in selecting the proper plastic for a given application should be, first, to choose the material most resistant to the chemical exhaust (and the external environment) and, second, to apply engineering design which will utilize the favorable physical properties (or circumvent the unfavorable physical properties) of the chosen plastic.

Cost

It can be stated quite generally that all-plastic ventilation equipment and parts are not cheap, especially in their initial cost. Where relatively mild corrosive environments are present or where temporary protection against corrosive conditions is required, all-plastic fabrications may not seem to be warranted. They might not be able to compete, price-wise, with other applicable materials.

For example, in most instances the initial cost of plastic exhaust hoods, ducts and stacks is higher than that of coated steel or other metals such as aluminum

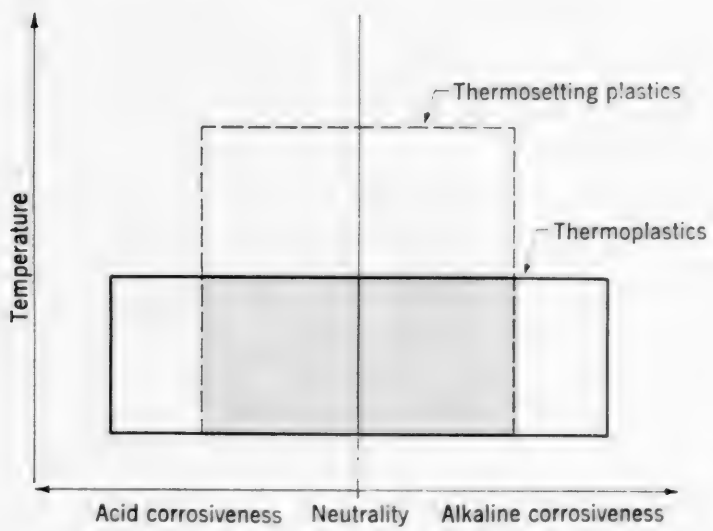


Fig. 7. Chemical resistance range of thermoplastics and thermosetting plastics is shown here in general terms to graphically illustrate their relative fields of service.

Key to Table 2

X — No attack or generally insignificant
VS — Very slight attack
S — Slight attack
A — Attacked severely

TABLE 2—RELATIVE CHEMICAL RESISTANCE OF VARIOUS THERMOPLASTICS AND THERMOSETTING PLASTICS

Generic Type	Acids		Alkalies		Organic Solvents
	Weak	Strong	Weak	Strong	
Polyvinyl Chloride	X	X	X	X	A (Aromatics and Ketones) X (Aliphatics)
Polyethylene	X	VS*	X	X	X
Chloro-trifluoro-ethylene (Fluorocarbon)	X	X	X	X	X
Phenolic (Asbestos-fiber reinforced)	VS	VS*	S	A	X
Polyester (Glass-fiber reinforced)	X	S	S	A	S
Epoxy (Glass-fiber reinforced)	X	S	X	S	X
Furan (Glass-fiber reinforced)	X	X	X	S	X

* By oxidizing acids

or stainless steel. This is due to high material costs and generally higher fabrication costs, as well as the necessity for special support arrangements.

As an example, the initial cost for a typical straight duct section, 24 inches by 24 inches by 5 feet long, would be approximately the following in these various materials:

Mild Steel (14 gage)	$ 25.00
Aluminum (20 gage)	100.00
Stainless Steel (20 gage)	125.00
Solid Rigid PVC (¼")	140.00
Polyester-Glass (3/16")	140.00

However, one should not overlook the lower installation cost of plastic duct systems, also their lower shipping weights and other reduced handling problems.

Also, in view of the exceptional chemical resistance of the various plastic materials of construction discussed here, there is hardly any relationship between this initial cost and long-term costs. Not only are maintenance and replacement costs kept to a very low level, but also costly operation shut-downs are overcome.

TABLE 3—AVERAGE PHYSICAL PROPERTIES OF VARIOUS THERMOPLASTICS AND THERMOSETTING PLASTICS

Generic Type	Specific Gravity	Maximum Tensile Strength, in Psi	Flexural Strength, in Psi	Compressive Strength, in Psi	Coefficient of Linear Expansion 10^{-5} Inch/Inch Deg F	Heat Distortion Temperature, Deg F @ 66 Psi	Flammability
Polyvinyl Chloride	1.4	9000	10,000	10,000	4.4	165	Self Ext.
Polyethylene (Low density)	0.92	1800	1700	——	30	120	Slow
Polyethylene (High density)	0.96	4400	1400	2440	7.2	170	Slow
Polyester (Glass-fiber reinforced)	1.8	41,000	38,000	40,000	4.0	300	Slow
Phenolic (Asbestos-fiber reinforced)	1.7	3500	6500	11,000	1.8	300+	Self Ext.
Polypropylene	0.90	5000	8100	——	4.7	220	——

Safety Precaution

It might be well to inject a word of caution regarding the use of plastics for ventilating and exhaust systems. Frequently the rapid flow of exhaust gases and dust particles through the inside of a plastic duct will induce a static charge on the outside surface of the duct. This will accumulate and lead to a rapid discharge as a hot spark which can be extremely hazardous in areas where flammable liquids or dusty conditions exist. Danger from explosion can be remedied by proper grounding. Continuous circumferential spiral wrapping of the duct with copper wire on 1-inch centers, and four longitudinal copper strips 90 degrees apart which are grounded to adjacent structural steel is one of several successful methods which have been employed. Imbedment of coiled wire within the plastic laminates is equally acceptable.

The Future

Manufacturers of these plastic materials admittedly have their sights set higher than corrosive applications only. They ultimately feel that their materials will be found suitable and acceptable for general air conditioning applications. Their reasons:

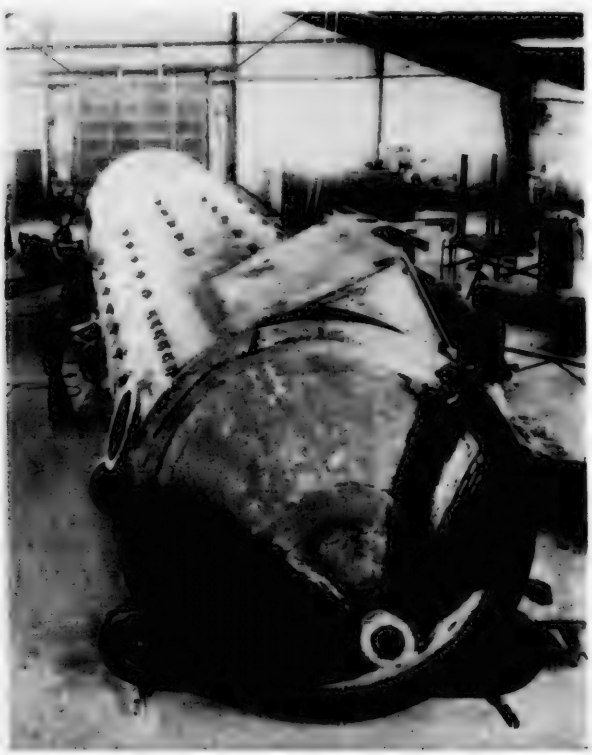


Fig. 8. Over 47 ft high and 10 ft in diameter, this chemical fume scrubber is made of polyester resin, glass-fiber reinforced. The 42,000-cfm unit was designed and engineered by Buffalo Forge Air Cleaning Div., Buffalo, N. Y., for an eastern metallurgical processing company. Plastic is a product of Durez Plastics Div., Hooker Chemical Corp., North Tonawanda, N. Y.

Fig. 9. The basic principle of the jointing technique shown in Fig. 6 can also be applied to the rehabilitation of corroded ducts. Here, glass mat, impregnated with resin, is wrapped around corroded sheet metal duct. The old duct inside its leakproof plastic covering will gradually corrode away. Photos, Heil Process Equipment Co., Cleveland.

1. In exposed locations, plastics are untouched by ordinary atmospheric corrosion; in concealed installations, plastics would be maintenance free. Here, polyvinyl chloride enjoys an advantage in its non-flammable nature.

2. Plastic ducts eliminate the insulation which is added to conventional galvanized ductwork.

3. Plastic ducts have, and, more important, will retain an extremely smooth surface, resulting in a permanently low friction factor for air flow.

4. Current experimental work shows that the sound attenuation characteristics of, in this case, PVC as compared with metal are such that higher velocities of the air in the ducts can be tolerated. This permits the cross-section of the ducts to be considerably reduced, thus lowering the installation cost.

5. Finally, should color ever become a factor in exposed air conditioning ductwork, the various plastics are available in a virtually unlimited range of hues.

However, it is felt that the foregoing is dependent upon the plastics becoming generally available in extruded lengths of duct, rather than their present status of either pre-fabricated or field-fabricated sections, for economic reasons.

Acknowledgement

For their valuable contributions to the preparation of this article, the author would like to express his appreciation to:

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James M. Brady, general sales manager, Haveg Corp., Wilmington, Del.

CHECK LISTS AND BID FORM FOR CONTRACTORS

Job cost and overhead items in the following check lists can be conveniently totaled in the accompanying bid summary form. Lists and bid form were developed by the Minneapolis and Saint Paul Associations of Plumbing, Heating and Mechanical Contractors as an estimating guide. Released through the National Association of Plumbing Contractors, they are reproduced by permission.

Check List 1
Direct Job Costs

EXPLANATION: This category of costs includes actual materials, apparatus, productive field payroll and supervision consisting of superintendent, foremen, etc., and usually includes items such as:

1. Materials and equipment and margin for escalation.
2. Labor—Regular and premium time and any anticipated increases, for: Journeymen such as Plumbers, Fitters, Laborers, Apprentices, Truck Drivers, Equipment Operators, etc.
3. Fringe benefits on labor—
   (a) Apprenticeship Fund
   (b) Credit Union
   (c) Health and Welfare
   (d) Pensions
   (e) Vacations
4. Travel and living expense—
   (a) Union Men
   (b) Home Office Supervision
5. Engineering—Shop fabrication detailing, etc.
6. Office personnel employed at the field office—timekeepers, clerks, engineers, etc.
7. Insurance and taxes on all job labor.
8. Welding consumables—rod, oxygen, acetylene, demurrage on cylinders, etc.
9. Setting and alignment of equipment.
10. Cutting and patching
11. Excavation, backfill and compaction.
12. Foundation and bases.
13. Insto gas and Prestolite.
14. Lead and oakum.
15. Painting and tagging job.
16. Sleeves and inserts.
17. Solder and flux.
18. Soil tests.
19. Freight and express on materials.
20. Testing and adjusting systems.
21. Final job inspection and punch list.
22. Final job cleanup.
23. Sub-contracts and bonding of subs, when required.

Check List 2
Miscellaneous Direct Job Costs

EXPLANATION: These are other costs directly computable and chargeable to the specific job being bid such as:

1. Special risk insurance.
2. Shop drawings.
3. Scaffolding and rigging.
4. Equipment rental or depreciation.
5. Small tools— % of total labor.
6. Special tools and equipment.
7. Distribution materials on job site.
8. Drayage.
9. Mobile equipment—assigned to the job such as trucks, cars, etc.
10. Gas, oil, repairs for—
    (a) Mobile equipment on job
    (b) Welding machines, pumps, etc.
11. Certification of welders.
12. X-Ray expense for welding tests.
13. Electric power and light—as pro-rated against you by specifications.
14. Electric switchgear and wiring expense for—welders and power tools.
15. Testing materials.
16. Temporary heating—labor, insurance and taxes, materials, etc.
17. Temporary toilet facilities.
18. Temporary water.
19. Job telephone, telegrams and postage.
20. Job shacks—trailers, shacks, warehousing, etc.,—cost on and off job.
21. Freight on tools and equipment —on and off job.
22. Delay penalties.
23. Job photographs.
24. Safety requirements.
25. Interest on borrowed funds—to finance and carry job.
26. Permits and licenses.
27. Payment and performance bond.

Check List 3
Overhead Costs

EXPLANATION: These items are applicable to all jobs and not directly allocable to any one particular job you may be bidding. For example: estimating services and home office rent. This item of cost usually includes all expenses such as:

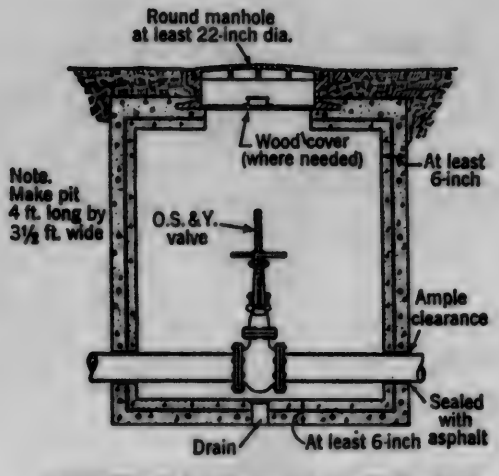
1. Accounting and legal.
2. Salaries—Officers
   Others—estimators, engineers, bookkeepers, clerks, etc.
3. Automobile and truck expense — (for amounts not charged to specific job).
4. Civic organizations.
5. Contributions.
6. Depreciation.
7. Dues and licenses.
8. Entertainment.
9. Interest.
10. Advertising.
11. Insurance—
    (a) General such as: auto and trucks, fire, floaters, etc.
    (b) Payroll.
12. Heat, light, power and water.
13. Real and personal property taxes and payroll.
14. Telephones and telegrams—intercoms, extensions and regular services.
15. Janitor and laundry services.
16. Maintenance of buildings, etc. —office and warehouses.
17. Repairs and rental of equipment.
18. Stationery, supplies and postage.
19. Warehouse expense.
20. Small tools.
21. Travel and promotion.
22. Miscellaneous.

BID SUMMARY

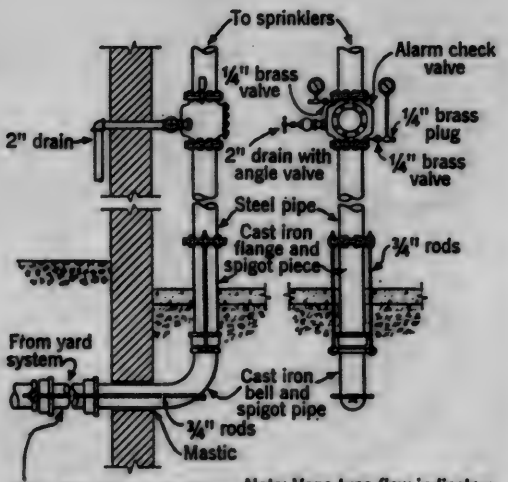
Direct Job Cost—(See Check List 1)		
Materials and Apparatus	$_____	
Escalation	$_____	
		$_____
Labor—including all supervision	$_____	
Increases	$_____	
Premium Time	$_____	
Fringe Benefits	$_____	
		$_____
Insurance and taxes on labor		$_____
Miscellaneous Direct Job Costs: (See Check List 2)		$_____
	Sub-Total	$_____
Sub-Contracts		$_____
	Sub-Total	$_____
Overhead and Profit: (See Check List 3)		$_____
	Sub-Total	$_____
Bond		$_____
	Bid	$_____

SPRINKLER SYSTEMS

Details of Installation and Hookups


Round manhole at least 22-inch dia.
Wood cover (where needed)
At least 6-inch
Note. Make pit 4 ft. long by 3½ ft. wide
O.S. & Y. valve
Ample clearance
Sealed with asphalt
Drain
At least 6-inch

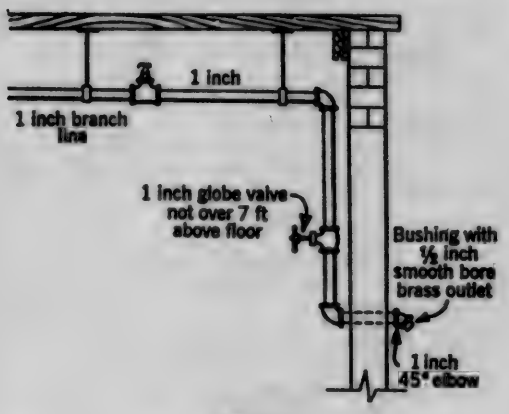
CONCRETE PIT FOR SPRINKLER CONTROL VALVE



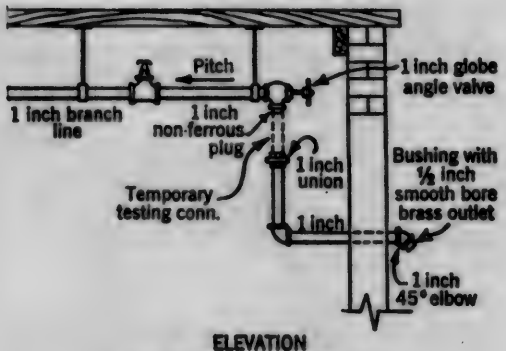
Note: Vane type flow indicators should be located above the 2" drain.

Complete trimmings of alarm check valve are not shown.

TYPICAL ARRANGEMENT AT BASE OF RISER

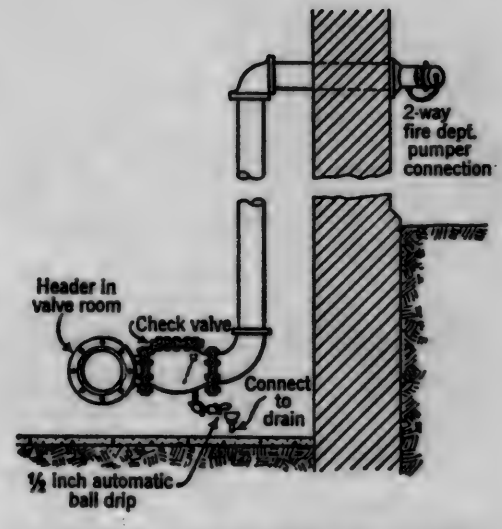

1 inch
1 inch branch line
1 inch globe valve not over 7 ft above floor
Bushing with ½ inch smooth bore brass outlet
1 inch 45° elbow

ELEVATION
Wet pipe systems



ELEVATION
Dry pipe systems

ONE-INCH SYSTEM TEST PIPES



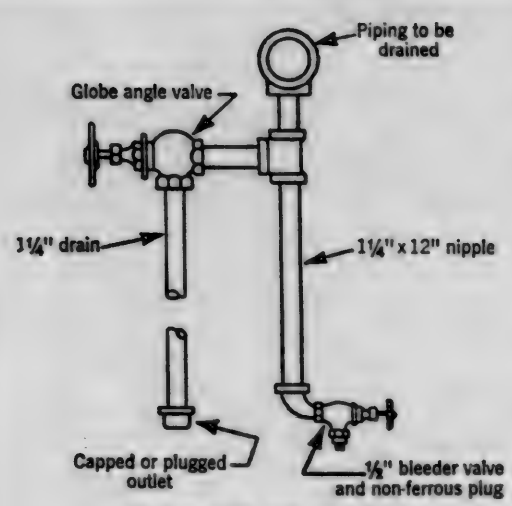
FIRE DEPARTMENT PUMPER CONNECTION

DETAIL SHEET—AIR CONDITIONING, HEATING AND VENTILATING

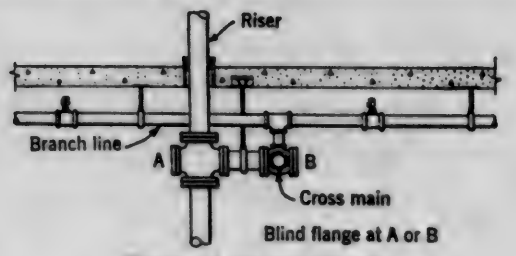
October, 1960

SPRINKLER SYSTEMS

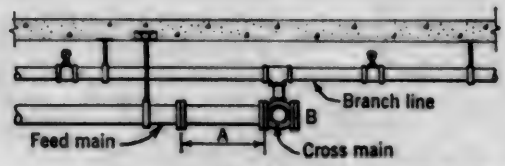
Details of Installation and Hookups



AUXILIARY DRAIN FOR MORE THAN TWENTY DRY-PIPE SPRINKLERS



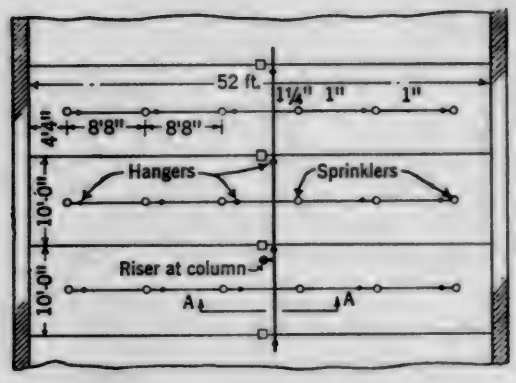
Elevation at riser and cross main

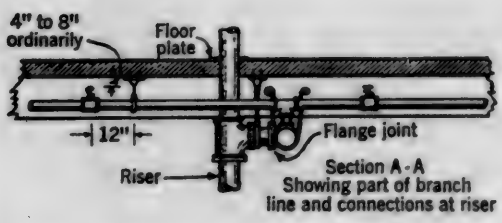


24-inch flanged removable section at A or blind flange at B

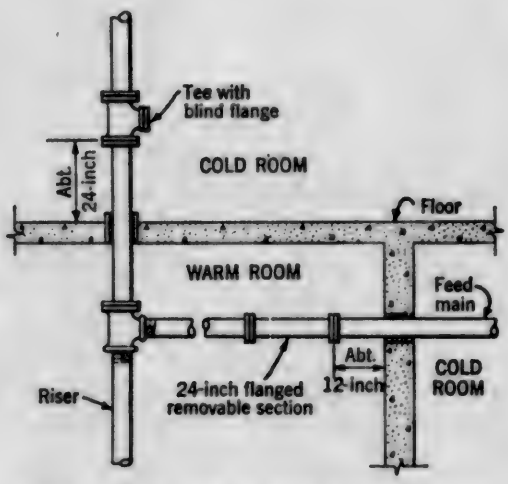
Elevation at feed main and cross main

FITTINGS TO FACILITATE EXAMINATION OF FEED MAINS, RISERS, AND CROSS MAINS IN FREEZING AREAS





LAYOUT FOR SPRINKLERS UNDER MILL CONSTRUCTION



FITTINGS IN FEED MAIN OR RISER PASSING THROUGH WALL OR FLOOR FROM WARM ROOM TO COLD ROOM

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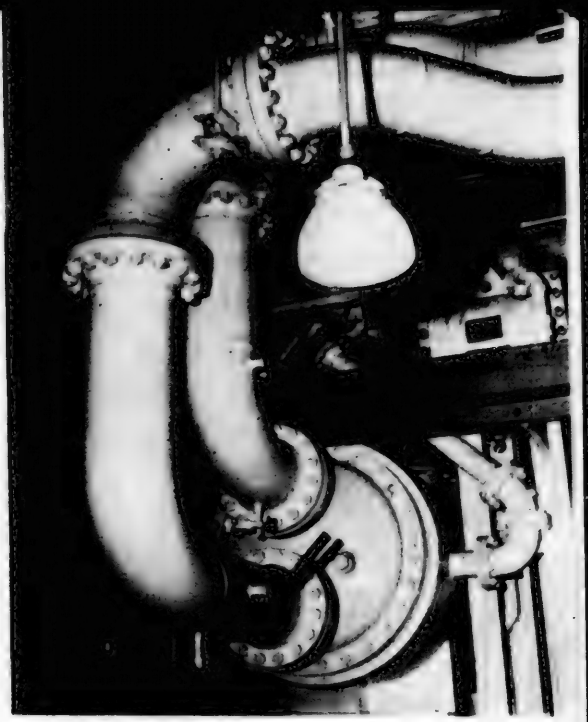
Proper selection and use of

Forged Steel Flanges



E. F. HARRINGTON
Tube Turns Div., Chemetron Corp.
Louisville, Ky.

A knowledge of the various types and classes of flanges, plus the ability to judiciously apply the right one to a given pipe line or pressure vessel, can mean reduced installed costs and improved system performance. Here is a review of flanges and facings, with an emphasis on proper application that tells "why" as well as "where."

FORGED STEEL FLANGES are employed in virtually all industrial piping systems and have an important influence on the cost, efficiency and service life of such installations. Use of a flange that is heavier than necessary for the safety requirements and functional needs of the operation involved is clearly an unjustifiable luxury. On the other hand, the employment of a threaded flange in a pipe line subjected to severe cyclic bending could result in early leakage or structural failure. Patently, the selection and application of these components deserves careful consideration in order to assure maximum economic benefits for both the user of the piping and the contractor who installed it.

Space does not permit a comprehensive discussion of all the aspects of proper flange selection, or even a critical analysis of some of the principles involved. Accordingly, this article will be limited to a general review of flanges generally available to the piping designer, erector or fabricator, together with application suggestions that can result in reduced costs and improved performance.

Edward F. Harrington received his B.S. degree in mechanical engineering from Northeastern University following wartime service as a Naval aviator. He was connected with the Worthington Pump Company prior to joining Tube Turns' Product Engineering and Research staff. Named to the sales engineering group in 1954, he was appointed manager of the Sales Development Department in 1958. A specialist in flange design and piping materials, he is a member of ASME, AGA, SGA, API and AMA.

ASA Flanges Most Frequently Used

The vast majority of flanges used in industrial piping are those made in conformance with American Standard ASA B16.5 and which mate with standard ASA valves.

In steel, these flanges are designated in series corresponding with their primary or nominal pressure ratings; i.e., 150-lb, 300-lb, 400-lb, 600-lb, 900-lb, 1500-lb and 2500-lb. For carbon steels, these ratings are applicable at 500 deg F for the 150-lb series and at 850 deg for all other series. For other metals, the primary rating temperature varies with the alloy.

Except for the 150-lb series, which is limited to a maximum pressure of 275 psi, these flanges in ordinary steel alloys can be used at temperatures between —20 and 100 deg at pressures up to 2.4 times the nominal rating. A 600-lb flange, for example, can be used for services involving 1440 psi when operating temperatures are 100 deg.

Parenthetically, it might be noted that the current edition of ASA B16.5 gives only one table of pressure-temperature ratings applying to all standard flange facings. The old Class B ratings providing lower secondary (cold-service) values for certain flange facings were eliminated in 1956. Acceptance of these higher

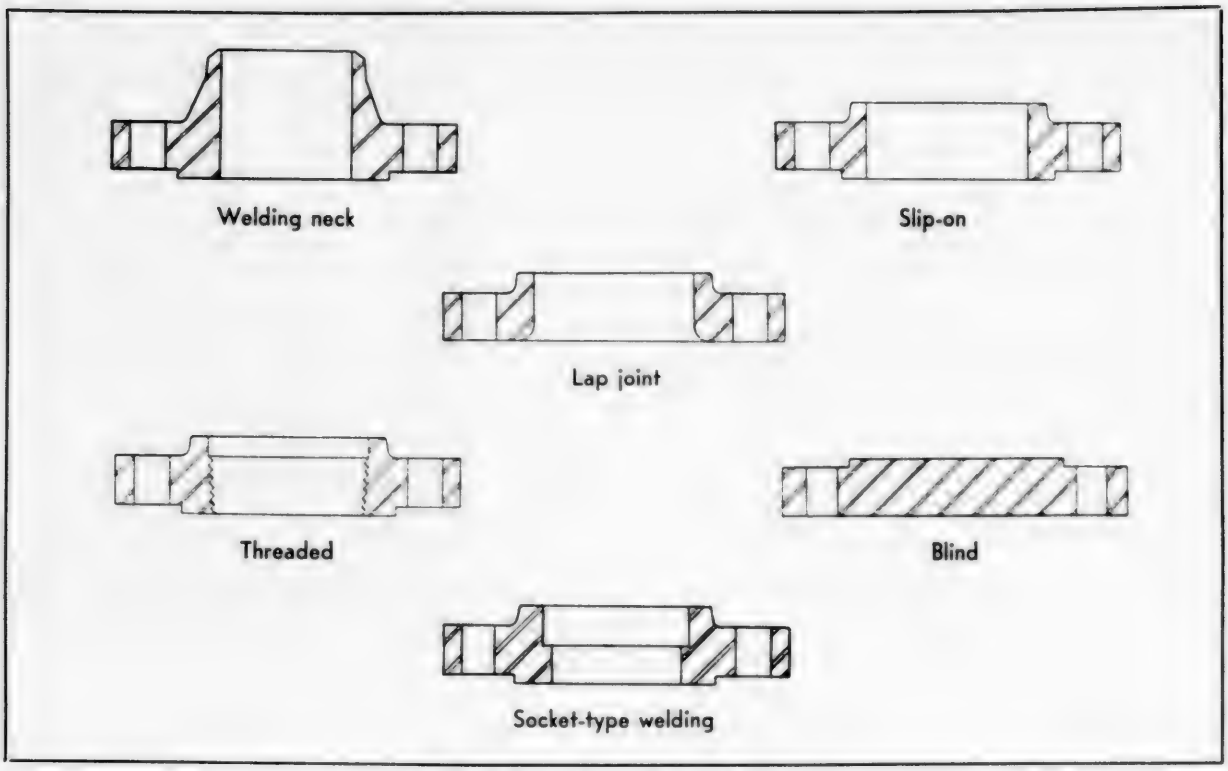


Fig. 1. Principal types of steel flanges.

ratings for all flange facings has meant substantial savings to the customer who prefers to use a raised-face flange instead of the more-costly ring-type or small tongue-and-groove type design.

Flanges for attachment to pipe larger than 24 inches nominal O.D., or for applications involving temperatures above 1500 deg or pressure greater than 6000 psi are not covered by ASA B16.5.

Several Types of ASA Flanges

ASA B16.5 provides standard dimensions for several types of flanges, each having inherent economic or engineering advantages.

Welding neck flanges are distinguished from other types by their long tapered hub and gentle transition of thickness in the region of the butt weld joining them to the pipe. The long tapered hub provides an important reinforcement of the flange proper from the standpoint of strength and resistance to dishing. The smooth transition from flange thickness to pipe wall thickness effected by the taper is extremely beneficial under conditions of repeated bending caused by line expansion or other variable forces, and produces an endurance strength of welding neck flanged assemblies equivalent to that of a butt-welded joint. This type of flange is preferred for every severe service condition, whether loading conditions are substantially constant or fluctuate between wide limits.

Slip-on flanges are preferred by many contractors because of low initial cost, reduced accuracy required in cutting the pipe to length, and the somewhat greater ease of alignment of the assembly; however, the installed cost of a properly made slip-on flanged assembly is probably not much, if any, less than that of a comparable welding neck flanged assembly because two fillet welds are required to attach the slip-on flange to the pipe, while only one butt weld is needed when a welding neck flange is used. The strength of a slip-on flange under internal pressure is ample for its ASA rating but its life under fatigue conditions is only about one-third that of welding neck flanges. Slip-on flanges are shown for all sizes up to and including the 900-lb standard in ASA B16.5, but are limited in sizes ½ to 2½ inches in the 1500-lb standard and are not included in the 2500-lb series. Section I on Power Boilers of the ASME Boiler and Pressure Vessel Code, furthermore, restricts the use of slip-on flanges to sizes 4 inches and smaller.

Lap joint flanges (also known as Van Stone flanges) are employed with lap joint stub ends, the combined initial cost of the two items being approximately one-third higher than that of a comparable welding neck flange. The chief use of lap joint flanges in carbon or low-alloy steel piping systems is in services requiring frequent dismantling for inspection or cleaning, and where the ability to swivel flanges and to align bolt holes materially simplifies the erection of large diameter lines or unusually stiff piping. The fatigue life of the lap joint flange is only one-tenth that of welding neck flanges. The use of lap joint flanges at points where severe bending stresses occur should be avoided.

Threaded flanges made of steel are available in all sizes up to and including the 900-lb standard, and through the 12-inch size in the 1500-lb and 2500-lb

standard. However, in the higher pressure series they should be confined to special applications. Their chief merit lies in the fact that they can be assembled without welding. A type of joint in which the gasket bears on the ends of the pipe uses threaded flanges for extremely high pressure services, where heavy wall and alloy steel is essential for strength, and where preheating and/or stress relieving of a welded joint is impractical. Threaded flanges, which depend on threads to seal, are unsuited for conditions involving temperature or bending stresses of any magnitude, particularly under cyclic conditions where leakage through the threads may occur. Seal welding is sometimes employed to overcome this difficulty, but this cannot be considered as a fully satisfactory solution.

Socket welding flanges were developed primarily for use with small high pressure piping. Their initial cost is about 10% greater than that of slip-on flanges. When provided with an internal weld, their fatigue strength is 50% greater than that of a double welded slip-on flange and their static strength is equal to that of the slip-on type.

Blind flanges are used to blank off the ends of piping, valves and pressure vessel openings. From the standpoint of internal pressure and bolt loading, blind flanges are the most highly stressed of all ASA flange types, since the maximum stresses in a blind flange are bending stresses at the center; however, higher stresses in this area can safely be permitted than in other types of flanges.

(An increasingly popular alternate to the blind flange is the hinged closure, which can often be used to advantage where disassembling and re-assembling blind flanged connections is time-consuming or cumbersome. Hinged closures manufactured by the author's company are factory-assembled units consisting of a welding hub, a hinged blanking head, a two-piece yoke assembly and a suitable gasket. Back faces of the head and hub laps are tapered to match the internal bevel of the yoke halves so that hub and head are forced together when the yoke is closed. When the yoke holding-bolts are turned, the yoke halves are separated and allow for the head to be swung open on its hinges.

Originally developed for the oil and gas industries, this closure device has many applications in other fields where frequent access to pipes or vessels is required. It affords substantial economies in installation since it is tied into the pipe line or vessel with only one circumferential butt weld. The closure can be opened by one man using only a standard wrench in a matter of minutes; hence, operating costs are greatly reduced.)

Facings for ASA Flanges

The *raised* face is the most common facing employed with steel flanges; it is $\frac{1}{16}$ inches high for 150-lb and 300-lb flanges, and $\frac{1}{4}$ inches high for all other pressure classes. The facing is machine-tool finished with spiral or concentric grooves (approximately 1/64 inches deep on approximately 1/32-inch centers) to bite into and hold the gasket. Raised face flanges generally are installed with flat ring composition gaskets. Figure 1 illustrates this and the following types of flange facings.

Fig. 2. Facings employed with steel flanges.

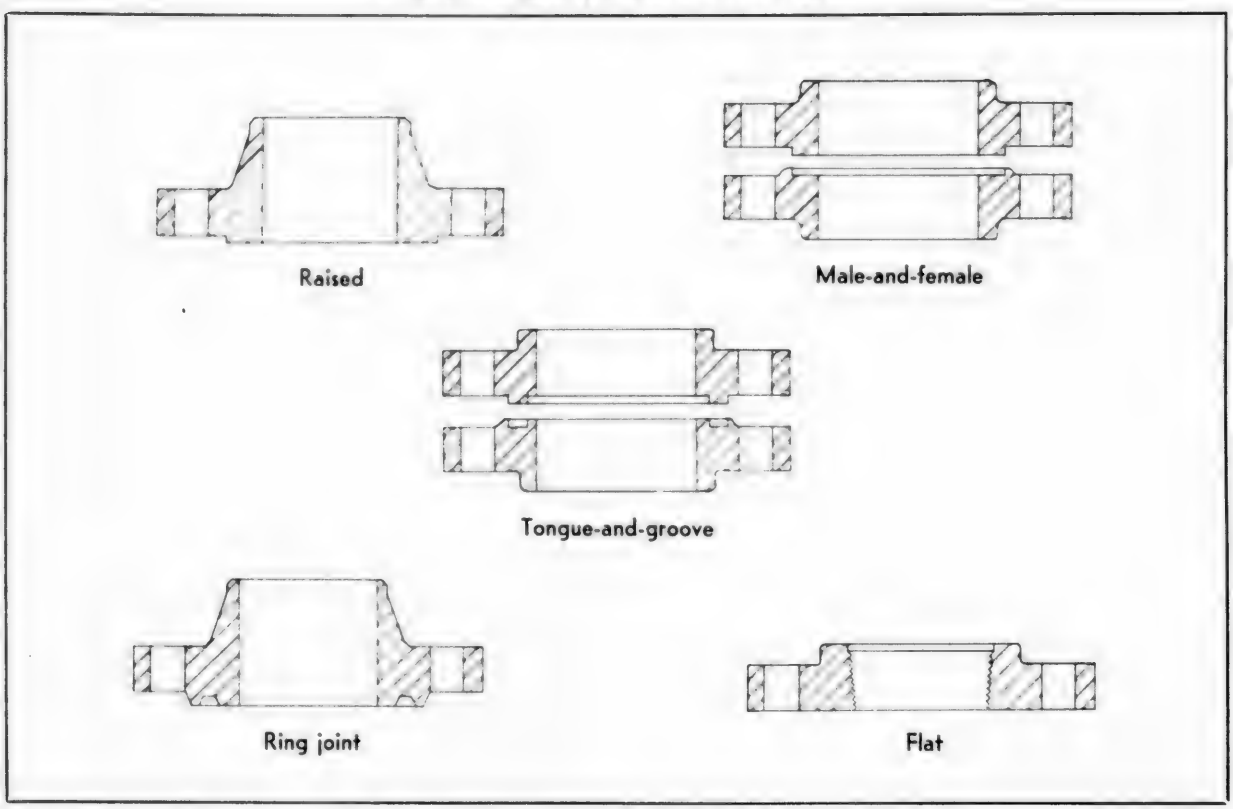


TABLE 1—NON-SHOCK PRESSURE RATINGS FOR WELDING NECK STEEL FLANGES WITH TAPERED FACES

Size in Inches	Temperature in Deg F							
	150	200	250	300	338	353	400	450
	Pressure in Psi							
1-12	175	163	150	138	128	125	113	100
14-24	150	137	123	110	100	96	84	70

Male-and-female facings are standardized in both the large and small sizes. The female face is $\frac{3}{16}$ inches deep and the male face $\frac{1}{4}$ inches high, and both are usually smooth finished since the outer diameter of the female face serves to locate and retain the gasket. The width of the large male and female gasket contact surface is excessive for use with metal gaskets. The small male-and-female design overcomes this difficulty, but provides too narrow a gasket surface for threaded flanges assembled with standard weight pipe.

Tongue-and-groove facings are also standardized in a large and small type. They differ from the male-and-female type in that the inside diameters of the tongue and the groove do not extend into the flange bore, thus retaining the gasket both on the inner and outer diameter. This serves to remove the gasket from corrosive or erosive contact with the line fluid. The small tongue-and-groove type, by virtue of the narrow gasket contact surface, requires a minimum bolting load for compressing the gasket and hence provides the highest joint efficiency generally available with use of a flat gasket. However, the bearing area of the small tongue is only about one-third as great as the total bolt area in several sizes of the 2500-lb standard, hence the possibility of failure due to compressive creep must be considered when using such joints for high temperature service.

The *ring joint* facing is the most expensive standard facing, but for use with oil or refinery services it is usually regarded as the most efficient, partly because internal pressure acts on the ring to increase the sealing force. Both flanges of a pair are alike, thus reducing stock and assembling problems found with both the male-and-female and the tongue-and-groove types of flanges. Because the surfaces of the gasket contacts are below the flange face, the ring joint facing is least likely of all facings to be damaged in handling or erecting. Because of the need to move the pipe axially to replace a valve with ring joint facing they are not the preferred design for all oil piping. Ring joint facings have not been generally accepted for steam plant usage because of early difficulties, which may have been due to compressive creep of the soft iron rings used at too high temperatures.

Flat face flanges generally are made by machining off the $\frac{1}{16}$-inch raised face of a 150-lb and 300-lb flange. Their chief use is for mating with 125-lb and 250-lb cast iron valves and fittings. With this type facing, a full face gasket whose outer diameter equals that of the flange is generally specified. In this manner the danger of cracking the cast iron flange is lessened; at the same time, however, difficulties in maintaining a tight joint may be encountered.

Carbon Steel Welding Neck Taper-Face Flanges

The brittle nature of cast iron has always posed a problem when steel piping is to be joined to cast iron flanged valves, pumps or other equipment. Experience has shown that B16.5 150-lb steel flanges are too stiff to mate well with dimensionally equal ASA B16.1 Class 125 cast iron flanges. If a gasket wholly contained within the bolt holes is used, overtightening the bolts may create bending stresses sufficient to rupture the cast iron flange; if the raised face is machined off and a full-face gasket is used, a higher bolt load is required to effect a proper seal, and even then leakage may develop.

This state of affairs has led some engineers and contractors to abandon the use of Class 125 cast iron flanged components and specify those designed for higher pressures; e.g., Class 250 cast iron valves and fittings in conjunction with ASA 300-lb steel flanges. This is expensive of course, since Class 250 cast iron components cost $1\frac{1}{2}$ to 2 times as much as Class 125 components of equal size.

A more rational solution to the problem has been provided with the development of a new type welding neck steel flange with a tapered face, designed specifically for use in lightweight piping systems. Dimensionally, these flanges are similar to ASA 150-lb steel flanges in that flange diameter and drilling conform to this standard. Geometrically, however, they differ in three ways:

(1) The face has a $1\frac{1}{2}$ degree convex taper,

(2) The flange ring is about half the thickness of the ASA flange, and

(3) The hub is shorter and thinner.

The design concepts underlying these differences are as follows: The effect of the tapered face is to cause the bolt load to be concentrated initially at that portion of the full face gasket which is near the flange bore, thus minimizing the pressure and load. As the bolt load increases, the taper-face steel flange, being more flexible because it is thinner and has a less rigid hub, deflects toward the cast iron flange. With sufficient bolt load, the steel flange face will contact the gasket over its full width—thus limiting the stress which can be put on the cast iron flange—but there will still be a higher unit load on the gasket near the bore of the flange than would be the case if the steel flange had a flat face. This design thus combines the pressure containing advantages of minimum-width gaskets and the safety features of full-face gaskets which greatly reduce the danger of cast iron flange breakage.

Table 1 presents non-shock pressure ratings, conforming to American Standard B16.1, which have been assigned to these flanges.

Proof tests have shown that these flanges amply meet test requirements specified in applicable codes and standards, and are as safe, or safer, for use at the assigned ratings as Class 125 American Standard cast iron flanged fittings with which they are intended to be used.

TABLE 2—PRESSURE AND TEMPERATURE RATINGS FOR THREE CLASSES OF PRESSURE VESSEL FLANGES

Class	Size Range in Inches	Type	Temperature Range in Deg F	Maximum Non-Shock Service Pressure Rating in Psi	
				Grade II	Grade I
75	26-72	Welding neck	—20 to 450*	100	85
			—20 to 775**	100	85
			—20 to 450*	100	85
		Slip-on	—20 to 450*	100	85
175	26-72	Welding neck	—20 to 750	200	200
		Blind	775	200	180
		Slip-on	—20 to 650	200	170
			700	190	160
			750	170	150
			775	150	135
350	26-48	Welding neck	—20 to 750	375	375
		Blind	775	375	360
		Slip-on	—20 to 650	350	350
			700	350	340
			750	350	300
			775	315	280

* Service life limited to 450 deg with non-heat treated carbon steel bolts.
** Requires A261-BO or A193-B7 bolting or equivalent to be suitable for temperatures up to 775 deg.

They have had wide use in mild service applications such as heating, air conditioning and refrigeration piping and in gas distribution piping.

Pressure Vessel Flanges vs Pipe Flanges

Although the principal use of the so-called ASME flange is in the fabrication of pressure vessels, this design procedure is also adaptable to many large diameter general piping applications, and an ASME flange may be employed in place of an ASA pipe flange where bolting requirements and line stresses are not important considerations or can be properly evaluated and where ASA dimensions need not be met. Because its bolting circle is not determined by that of a mating valve and because its bolts do not handle line stresses, the ASME or pressure vessel flange is usually lighter—and correspondingly less expensive—than the ASA flange and its use as an alternate should always be considered when service conditions permit.

In the interest of clarity it is worth elaborating on these two readily apparent differences between pipe flanges and pressure vessel flanges. In the first place, ASA pipe flange design starts with a fixed bolt circle—matching that of the valve with which it is to be used. Because of the nature of the valve body, the bolt circle on the valve flange must necessarily be larger than is required solely for sound flange design while pressure vessel flanges are normally used to form a flanged union. Furthermore, in the ASME Code design, it is usually most economical to use small diameter bolts because they require less bolt head or nut clearance and consequently, the size of the bolt circle can be further reduced. Still further, the number of bolts in an ASA flange must be a multiple of four while any number can be used in a pressure vessel flange.

The only other real difference in philosophy is in the evaluation of stresses. As can be seen from Fig. 3, the pressure vessel flange problem is primarily one of supporting internal pressure. Bending moments, thrusts and pulls do not aggravate the problem of maintaining a leak-proof joint. Thermal expansion or contraction of the piping is the usual source of these disturbances, but mechanical vibration from pumps and turbines occasionally may be a factor. The ASME Boiler and Pressure Vessel Code, Section VIII, Paragraph UG 44, recommends that the dimensional requirements for bolted flanged connections to external piping conform to ASA B16.5 or other applicable ASA standards.

The ASA pipe flanges are assumed to have an average stress at the primary rating pressure of 8,750 psi. Computed stresses for individual sizes and types of flanges may vary more than 50% from this stress. The room temperature ratings are 2.4 times the primary ratings, giving a stress of 21,000 psi or approximately 60% of the minimum yield strength of 36,000 psi for A105 Grade II flange material. The stress corresponding to the 650-deg ratings for *all* carbon and alloy steels, except Type 304 stainless, is 15,100 psi. The

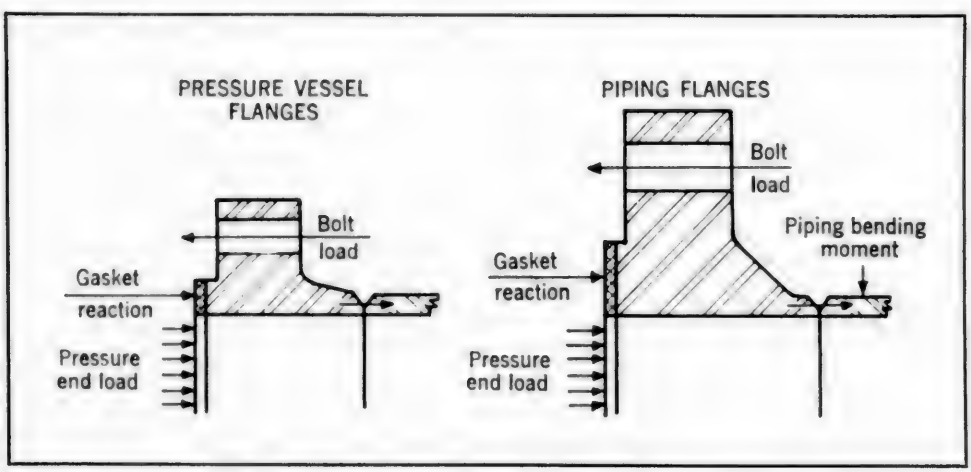


Fig. 3. Comparison of forces acting on pipe flanges and pressure vessel flanges.

TABLE 3—DATA ON THREE CLASSES OF LARGE-DIAMETER PIPE FLANGES

Class	Size Range in Inches	Type	Maximum Non-Shock Service Pressure Rating
125-lb Lightweight	26-72	Slip-on	100 psi at or near air temperature with full face gasket
125-lb Regular	26-60	Welding neck	Up to and including 48" Ratings per ASA B16.1
	26-96	Slip-on	50 psig Saturated Steam — 150 psi at 150 deg Water, Oil and Gas
250-lb Regular	26-48	Welding neck	Ratings per ASA B16b
	26-48	Slip-on	100 psig Saturated Steam — 300 psi water at or near atmospheric temperature

allowable design stress for A105 Grade II carbon steel in the ASME Boiler Code is 17,500 psi for all temperatures from −20 to +650 deg. Since the allowable design stress for A105 Grade I is only 15,000 psi at 650 deg, the ASME design will usually, but not always, be lighter for a given material and service condition.

The end result usually is considerable weight savings; in some cases an ASME pressure vessel flange weighs only half as much as an ASA pipe flange of comparable size. This saving in weight results from the proper proportioning and location of the bolting and from a full utilization of the supporting strength of a tapered hub of adequate strength.

Generally, pressure vessel flanges are furnished in carbon steel conforming to ASTM A181 Grade I or II. They may also be obtained in A105 carbon steel or in any other material that can be forged or rolled.

Table 2 gives pressure and temperature ratings permissible for given dimensions for the three commonly-accepted classes of pressure vessel flanges.

It should not be inferred, of course, that pressure vessel flanges are available only in sizes indicated in Table 2. Sizes above those shown are generally calculated and made on a custom basis. The trend of recent years, in fact, has been toward larger sizes with the 72 to 120-inch size range accounting for a growing percentage of designs.

Large Diameter Pipe Flanges

As pointed out previously, ASA B16.5 does not cover those flanges larger than 24 inches which are frequently required for certain low and intermediate pressure piping services. To free the user of such flanges from the work and expense of preparing individual designs, certain basic classes of large diameter flanges have been established through industry usage. The series, types and sizes in three of the more common of these classes are reviewed in Table 3.

Class 125-lb Lightweight ASA-type slip-on flanges These are used in applications calling for the least expensive type of flanged connection in large-diameter piping. Bolt circle and facing dimensions are the same as those of ASA B16.1 Class 125 cast iron flanges. The suggested rating of 100 psi at room temperature is conditioned on the use of a full face gasket and flat facing. The resistance of that part of the contact surface situated outside the bolt circle in such designs produces a counter-moment which effects a substantial reduction in the total moment causing rotation of the flange, and hence justifies a marked reduction in the flange thickness. By the same token, however, the bolt load required for joint tightness is increased and, for this reason, it is recommended that bolts superior in physical properties to those of ordinary un-heat-treated carbon steel be used.

Classes of large diameter flanges described as Regular ASA-type represent an extension of the size range of the 150-lb and 300-lb series of steel pipe flanges covered in ASA B16.5. This extension is effected by paralleling the 125-lb and 250-lb series of cast iron flanges covered in ASA Standards B16.1 and B16b, from which the two series of steel flanges were derived originally. This is perfectly logical since such flanges are normally required to connect with valves, pumps and similar equipment having flanged ends conforming with these cast iron standards.

The cast iron standards give flange diameter, thickness and bolt hole drilling dimensions but do not establish hub dimensions beyond the 24-inch size. For the Regular ASA-type large diameter flanges, hub proportions have been made as massive as compatible with the dimensions taken over from ASA B16.1 and B16b. Accordingly, such flanges can be rated as equal to cast iron flanges of the same pressure class as is recommended for ordinary uses.

Class 125-lb Regular ASA type. Where intended for bolting to cast iron valves or fittings, these should be used with a plain or flat facing. Gaskets should be of a soft, non-metallic material (paper, fiber, rubber or asbestos composition, depending upon the service involved). When a ring gasket is used, the gasket should extend to the inner edge of the bolt holes. The bolting should be carbon steel equivalent to ASTM A307 Gr B, without heat treatment other than stress relief so

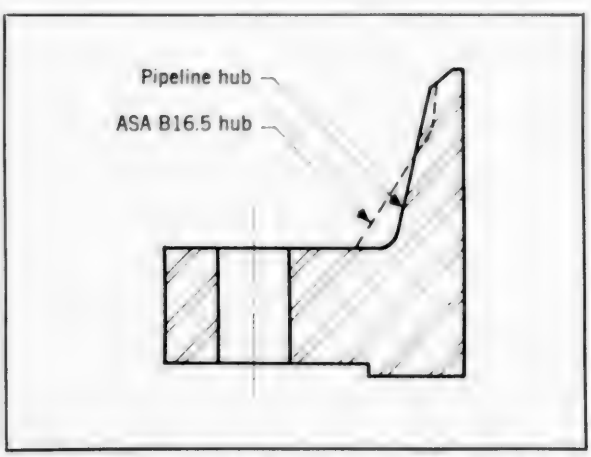


Fig. 4. Comparison of hub proportions of MSS and ASA welding neck flanges.

Fig. 5. Lightweight carbon steel taper-face welding neck flanges are used with a Class 125 cast iron gate valve in this 4-inch low-pressure steam line. All photos from Tube Turns Division, Chemetron Corp., Louisville, Ky.

that the bolts will yield and fracture without damaging the cast iron flange. When a full face gasket is used, the bolting should be heat-treated carbon steel (A261) or alloy steel (A193).

Class 250-lb Regular ASA-type. Where intended for bolting to cast iron valves or fittings having a $\frac{1}{16}$-inch raised face (as suggested in ASA B16b), these flanges may have a similar raised face or, preferably, they may be ordered with a plain or flat facing. In either case, the bolting should be carbon steel equivalent to A307 Gr B, without heat treatment other than stress relief for the previously-mentioned reason. Gaskets should be ring gaskets of soft, non-metallic material and should extend at least to the outside diameter of the raised face.

These bolting and gasket suggestions are intended to limit the maximum possible stress that may be placed on the cast iron flanges. Where these steel flanges are to be used as companion flanges (not matched up to cast iron valves, etc.), the use of a raised face is recommended. Higher service ratings are sometimes permitted in such applications.

(Again, it should be remembered that forged or rolled flanges can be furnished to any desired dimensions.)

MSS or Pipe Line Flanges

Although employed infrequently in industrial piping services, the MSS flange now represents an important percentage of total flange use and for this reason it should be mentioned briefly here.

These flanges are made in accordance with dimensions established in Standard Practice SP-44 of the Manufacturers Standardization Society, and are designed primarily for use with thin-wall high yield strength pipe in oil and transmission cross-country lines.

MSS SP-44 covers carbon steel welding neck and slip-on flanges in sizes 26 through 36 inches with regular ring-joint and raised facings. While designated by the customary ASA series of 300-lb, 400-lb, 600-lb and 900-lb primary ratings and while they can be safely used within these limits, the chief use of these flanges is in transmission piping at atmospheric temperatures and at pressures corresponding to the secondary ratings of ASA B16.5 flanges.

The principal design difference between MSS and ASA flanges, in addition to the larger sizes of the former, lies in the hub proportions. As illustrated in Fig. 4, the MSS hub has a single straight taper and the small end is slightly thicker than the matching pipe. This enables 36,000 psi yield strength flanges to be used with the higher yield strength pipe. By means of a tapered weld, this provides a more desirable stress distribution through the point of weld.

Welding neck and slip-on flanges in sizes of 24 inches and smaller are often required in installations involving thin-wall high yield strength pipe. Regular ASA flanges should be employed with discretion in such applications because of the possibility of overstresses due to differences in yield strength of the materials; eg., 36,000 psi flanges and up to 56,000 and higher psi run pipe. In such cases consideration should be given to the use of a modified ASA flange having the straight tapered type hub of the MSS design. Many times this is less expensive, and may also be the preferred design from an engineering standpoint.

Your Distributor Can Help

In conclusion, the author would like to reiterate the original premise that careful selection and proper application of flanges can result in substantial economies of installation and material improvement of operations.

Industrial distributor organizations usually are well informed on flange problems and are willing to help the user select the proper design. In many cases these firms have established highly specialized departments staffed by competent engineers whose sole responsibility is to provide technical assistance. The flange manufacturer, in turn, is prepared to provide support in depth on those problems requiring specialized knowledge and experience. It is strongly urged that the piping designer and contractor take full advantage of the services available from his distributor.

APPLICATIONS AND INSTALLATIONS

Air Conditioning for a Multi-Story Bank Building

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BUILDINGS, LIKE PEOPLE, have their own personalities and specific requirements and, accordingly, must be treated individually. In the initial planning stages of all buildings, the affected professions of architectural design, structural, mechanical and electrical engineering must be consulted. Building orientation, shading, ceiling heights, space allocations, mechanical requirements, lighting requirements and various other requirements must be studied carefully to provide the ultimate in client satisfaction at a minimum cost.

Initial Planning

The South Carolina National Bank, the state's largest, commissioned this architect-engineer group to do plans and specifications for a central office building for state-wide operations. It was decided to locate a multi-story building in Columbia, the State Capital, which is geographically centrally located. Specific requirements for the building were a main banking room approximately 60 by 60 ft, an I. B. M. area located directly below the banking area, four stories of offices with removable partitions, and six drive-in teller windows (only four were built). The entire bank building was to be completely air conditioned to provide individual control where at all practical and the ability to adjust quickly to changing heating or cooling loads.

In the preliminary design conferences, it was decided to orient the building axis in an east-west direction with the majority of the glass exposure in a north-south direction. This orientation minimized the cooling load and glare from the sun, and lessened the always troublesome zoning problems. The building was to be constructed principally of marble and glass. Due to the specific requirements for air conditioning, the building was broken down into three areas for design consideration.

At the outset, it was apparent that no single system would provide the essentials of a quality air conditioning system for the entire building. After carefully considering the many and varied systems available, the low pressure single duct, the dual duct, the induction and the fan coil systems were found to be those that could most probably be tailored to meet the building demands.

A hot water - chilled water system with fan-coil units and low velocity air handling units appeared to adapt most readily to the special uses and requirements of the building.

One of the most difficult acquisitions by an engineer in the planning of any building is adequate space for efficient mechanical system operation and preventive maintenance. Boiler room, refrigerating room, air handling rooms, duct shafts and cooling tower must all be so located and arranged so as to form compact, efficient systems utilizing the minimum floor space within the limits of good engineering design. Each particular building must be treated separately, and only through close and real cooperation and coordination between the architect and engineer can success be assured.

Equipment Location

The main equipment room was located in the subbasement with space for the 200-ton hermetic centrifugal water chiller, a gas-fired Scotch marine boiler, an air handling unit, water pumps, graphic control panel and other miscellaneous mechanical items. An adequately-sized areaway was provided for removal or replacement of any of the equipment through a removable wall louver. An additional

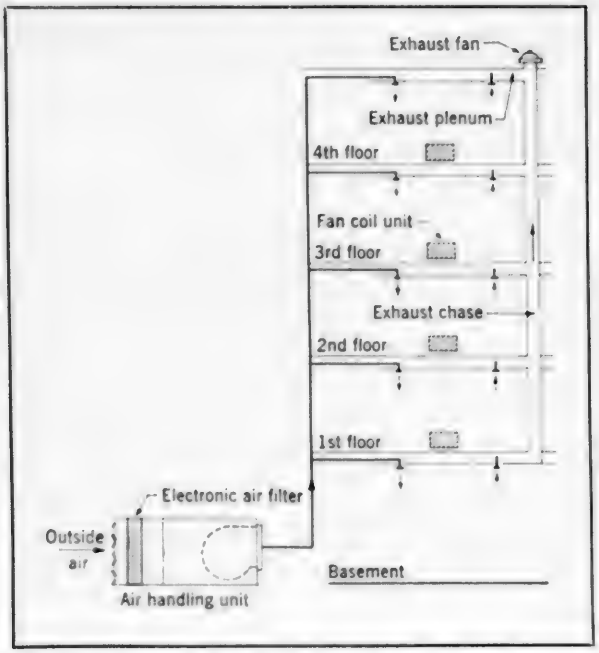


Fig. 1. Diagram of the air system serving the four-story office area.

room was located at the basement level for two single zone air handling units, while the cooling tower and power roof exhausters were located on the roof.

Four-Story Office Area

The first area to be considered consisted of the offices located around the periphery of each of four floors. All offices were formed with walls of movable partitions and, therefore, the air conditioning system had to provide maximum flexibility to condition future offices of varying sizes and shapes. Fan-coil units were strategically located so as to provide a minimum of one unit for each office. Each fan-coil unit was supplied with either chilled or hot water depending on the requirements of the zone served. Separate zone pumps were provided for the north and south zones so that the varying requirements for cooling or heating by either of the controlling building exposures could be accurately and quickly satisfied.

In the sub-basement of the building, a single zone, all outside air, air handling unit with steam grid humidifier was installed to supply the outside air requirements of the offices through a conventional low velocity duct system and square perforated ceiling outlets. As shown in Fig. 1, exhaust diffusers were also located in the ceiling, which served as a plenum, and connected to a vertical exhaust duct to assure positive relief of the excess air and to insure the introduction of design outside air requirements. The ceiling consisted of 2 by 4 ft lift-up type modular panels, thereby providing not only unlimited access but also a means of future rearrangement of the ceiling diffusers if office partitions are relocated.

Main Banking Room

The second area considered was the main banking room which is approximately 60 by 60 ft in floor area. There are three exposed exterior walls consisting entirely of glass approximately 17 ft in height. The architectural requirements dictated that any duct system would have to be located below the banking room floor and supplied by a single zone air handling unit located in the basement. Air was supplied to continuous strip line diffusers located in a 6-inch-high sill under the glass, seen in Fig. 3, and through four 34-inch round ducts, inside of structural columns, to high sidewall supply grilles. Two exhaust fans were located on the roof for positive exhaust of 100% of the supply air in the event of failure of the refrigeration machine.

I.B.M. Room

Directly under the main banking room is located the I. B. M. room for high speed, accurate and efficient processing of bank transactions. Due to the extremely high rate of heat liberation by the I. B. M. equipment when in operation, a separate single zone air handling unit located in the basement supplies conditioned air to the I. B. M. area through conventional low velocity duct work and ceiling diffusers. Thus with an independent system, comfortable conditions can be maintained regardless of the varying interior load.

Filtering

Each building must be carefully and analytically examined to see which, if any, specific considerations must be allowed for in the system design. All three air handling units were designed for the use of 100% outside air at varying conditions and, therefore, introduced the problem of adequate filtering of the air.

The location of the bank building, in an area of contaminated air resulting from both industrializa-

Fig. 2. View of the board room, part of the office-area system, shows concealed fan-coil units in wall on right, supply and exhaust diffusers in ceiling.

Fig. 3. View of main banking area shows continuous supply grille below glass at left, and high-level supply grilles in stainless steel columns.

tion of business and heavy automobile and truck traffic, necessitated the installation of a positive effective filtration system. In industrial areas, more than one-half of the contamination by weight is composed of particles the size of which is less than one micron. Mechanical and impringement type of filters are not very effective on dust and dirt particles of one micron or less; it was, therefore, decided to install electronic air filters for filtering all outside air. Electronic air filters properly sized and installed will, in most instances, remove 90% or more of all air-borne particles as small as .001 micron. Not only will electronic air filters provide cleaner air for its occupants, they will also reduce redecorating of the building interior and fixture cleaning.

Controls

The most carefully planned air conditioning system must have a "first class" control system if temperature and humidity are to be maintained to suit the desires of the occupants. Controls, along with the design of the system, possess the ability to provide cooling or heating in any area of the building in response to the controlling instrument. There are times when one zone may require heating and another zone requires cooling simultaneously. Only when required conditions of the various zones can be satisfied has the essential requirements of the air conditioning system been met.

The rapid growth of the modern air conditioning system has been accompanied by the introduction and use of increasingly complex controls. With the complex control system included in the bank building, it was quite apparent that the operating engineer would need aids to efficiently and economically operate and maintain the air conditioning system. It was, therefore, decided that centralization of the controls for all systems by graphic representation would be provided in the main equipment room.

Provisions on the graphic panel include:

1. Graphic representation of the three different air handling systems.

2. Gages to indicate the position of all automatic control valves.

3. Indicating lights to tell the operator when the fans and pumps are in operation.

4. Indicating temperatures including:

Chilled water temperature "in" and "out",
Condenser water temperature "in" and "out",
Hot water temperature "in" and "out" for each zone, and
Space temperatures for each zone.

It was felt that these items provided the essential elements pertinent to a control system from both the occupants' and operator's standpoint, and was yet maintained within the economic range for the size air conditioning system involved.

Conclusion

This system has been in operation for approximately two cooling seasons providing the occupants complete satisfaction for maintaining desired conditions. The entire air conditioning system from conception to completion was kept as simple as possible without sacrificing quality. As a result, the system was installed for $750.00 per ton of refrigeration, representing a very nominal cost for the quality of system installed. The system has thus far required a minimum of maintenance and has left the owner little to be desired from the standpoint of flexibility to meet the varying demands of the bank's occupants.

Successful Radiant Heating with Thermoplastic Pipe

HEATING ENGINEERS should take another look at a tough new polyethylene pipe for radiant heating applications, according to a plumbing and heating distributor from Indiana.

Reports George Needham, Jr., executive vice-president of Biggs Pump and Supply, Inc., Lafayette, Ind.: "Because of mistakes of the past, we purposely waited until our material had performed three years without a hitch before blowing our horn. (Earlier conventional polyethylene pipe in radiant heating had a history of failure, largely due to pin holing and slitting.)

"For the past three years we have pumped 110-deg F water at 15 psi through more than 2000 ft of polyethylene pipe buried in a concrete warehouse floor. Now we are ready to recommend this for a variety of heating applications, including snow removal."

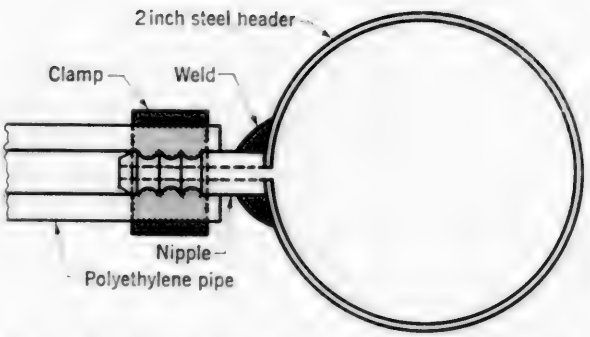


Fig. 1. Steel insert nipples were welded to supply pipe; a hole was then drilled through each nipple into pipe.

Radiant Heating Solves Rust Loss

The specific application described in Mr. Needham's report concerns a sheet metal warehouse built three years ago by his company to take care of rapidly expanding business.

Without uniform temperature control in the warehouse, the company knew its sheet metal stock was in for trouble with the rugged Indiana winters. "A bad streak of weather—a prolonged cold spell followed by a warming trend with high humidity—can ruin a good portion of sheet stock. What was needed was uniform heat throughout the metal stacks to prevent condensation."

Mr. Needham approached the Orangeburg Manufacturing Co., producers of Orangeburg SP high density polyethylene pipe, and enlisted this company's cooperation in planning a radiant heating system. The manufacturer had seen pin holing and slitting disappear as a problem, and so felt confident that its pipe would be the first polyethylene to succeed in radiant heating.

Time and Labor Saved

Over 2000 ft of polyethylene pipe—in 20 loops of 100 ft each—were installed by two men in 3½ hours in the 4000 sq ft warehouse space to be heated. While this is less than one-third the time it would take to put in metal pipe, it was reported, material costs are about the same.

Set on 18-inch centers, the loops were connected at each end to steel headers, as shown in Fig. 1. The inside radius on each loop was maintained at 18 inches.

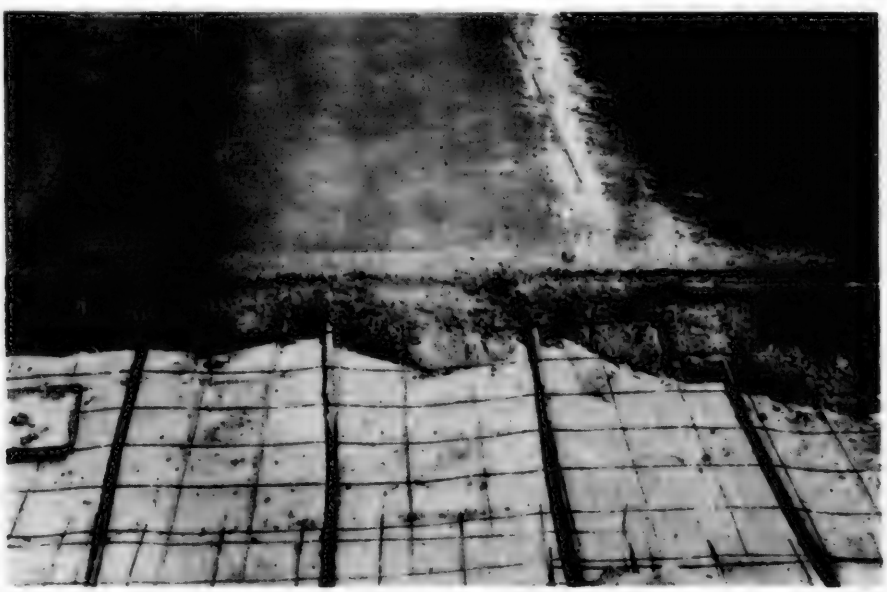


Fig. 2. Tied to 6 x 6 inch wire mesh, the pipe was pulled up into the concrete as it was being poured.

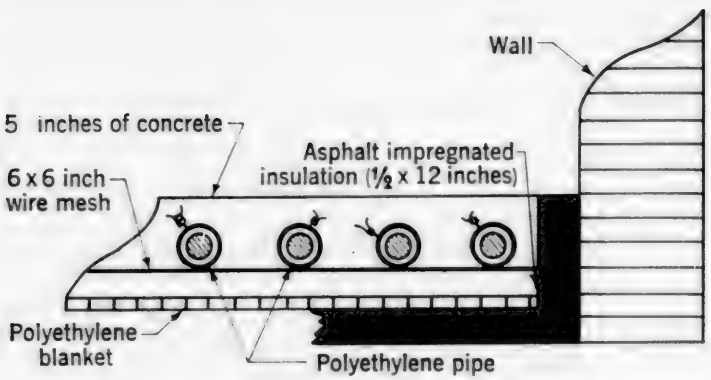


Fig. 3. Cross-section of floor showing asphalt-impregnated board and polyethylene blanket which insulated the concrete.

Water heated to 110 deg enters the polyethylene pipe through the entry and exits at a temperature of 100 deg. Air temperature in the warehouse is maintained at 65 deg; temperature of the sheet metal is slightly above 65 deg. "In spite of the fact that polyethylene is supposed to be a poorer conductor than metal, there is little difference in the radiant heat emitted by either material through concrete."

Installation is Simple

In the Biggs warehouse job, the polyethylene pipe was pulled up into the poured concrete by means of 6-inch-square wire mesh to which the pipe was wired, as shown in Fig. 2, with little concern about the level of the pipe in the concrete. The concrete floor, however, was well insulated beforehand with a special asphalt-impregnated board around the sides and bottom, plus a polyethylene blanket, as illustrated in cross-section of Fig. 3.

In the beginning, a pressure gage was used to detect any leaks in the system, but this was removed after none were noticed. In fact, the concrete is seen as further reinforcing and strengthening the walls of the polyethylene pipe.

Flameless Gas Heating

A flameless method of producing heat from gas has found limited application in the United States and Europe, but may prove much more important in the future. Called catalytic combustion, the method converts gaseous fuel to infra-red energy through the medium of a catalyst, often a metallic gauze surface.

In this combustion process, a gas-air mixture passes through a manifold, is diffuesd and preheated in a diffusing media, and then passes through a catalytically active metal gauze screen where flameless combustion takes place.

The basis of all catalytic processes is the ability of certain substances to speed up a chemical reaction without being changed in the process. An example is the flameless cigarette lighter that uses alcohol and a platinum wire screen.

This method, reports *LPGA Times*, official publication of the Liquefied Petroleum Gas Association, is reputed to have a greater combustion efficiency and to be therefore more economical than conventional methods because of its low-temperature conversion of fuel to radiant energy. Surface temperatures of the heater range from 800 to 1500 deg F, depending on the gas-air mixture. The catalytic heater actually operates below the flammable range of the gas.

Low temperature operation with longer wave lengths is particularly important in paint drying, the *Times* points out. Tests have shown that paint pigments absorb heat better at these longer wave lengths. One U.S. firm is working on LP-gas applications in the industrial field, with drying of wallboard panels as one end-use.

Already on the market is the Bernz drive-in movie car heater, using a refillable LP-gas bottle, which mounts in the car window. It is promoted on its economical combustion and safety features. Domestic heater models, in common use in England and Italy, are said to be undergoing tests at AGA Labs.

According to the *Times*, current interest seems to center around heaters having Btu ratings in the 4,000 to 10,000 range, although an English firm sells a model rated at 20,000 Btu, ignited by electricity. Suppliers' promotion points to operating costs on city gas that are less than for electricity.

While there is little likelihood of flameless heaters for central heating systems, they may become popular as bathroom heaters in residences. One is tempted to speculate about the possibility that they will supplant some of the higher temperature radiant heaters now used in multiples for industrial comfort heating.

Louis Blendermann on

PLUMBING and PIPING

Wall Mounted Water Closet Installations

FLOOR MOUNTED water closet installations and the amount of floor space such installations require were covered last month. This article discusses wall mounted closet installations.

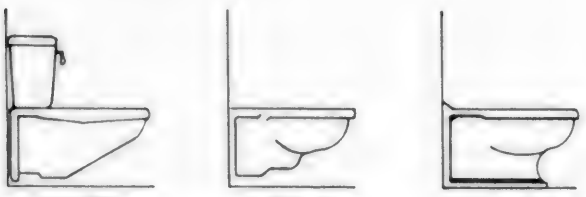


Fig. 1. Three basic types of wall mounted water closets.

With wall mounted closet installations as with floor mounted installations, much thought should be given to the placement of rest rooms. Economy in occupied floor space can be effectively gained when rest rooms are placed back to back rather than at separate locations. Furthermore, savings may be realized when a common set of risers is used to serve a back to back fixture installation rather than supply separate risers for individual locations.

Rest room locations is a detail that the engineer must work out with the architect.

Types of Water Closets

Since only wall type closets are to be discussed, only the basic styles of the general types available are included. They are the closet combination, the regular closet and the secured type closet, all shown in Fig. 1.

The closet combination or residential closet is available in several different types, some of which include an exposed tank as shown or a tank that is concealed in the wall construction. This closet is intended primarily for the private residence and the water for the tank is supplied by a small diameter water line.

The regular closet is also available in a number of different styles and shapes of which, the blow-out and siphon-jet depicts the flushing action of each closet. The regular closet is used in all types of buildings. The siphon-jet, because of its quiet action, is preferred in buildings where sound has to be held down. The blow-out closet is utilized in areas where sound is not an important factor and a strong flushing action is desired.

The secured type closet is generally installed in institutions or where it is desired to secure the closet to both the floor and wall to prevent its being torn loose. This closet is equipped with a concealed flush valve. The secured closet in this case differs from the secured closets featured for the floor mounted closet installations, in that the discharge outlet is extended through the wall.

Closet Combinations

The closet combination or residential closet is generally installed in private homes where the pipe space or wall construction is of narrow proportions as shown in Fig. 2.

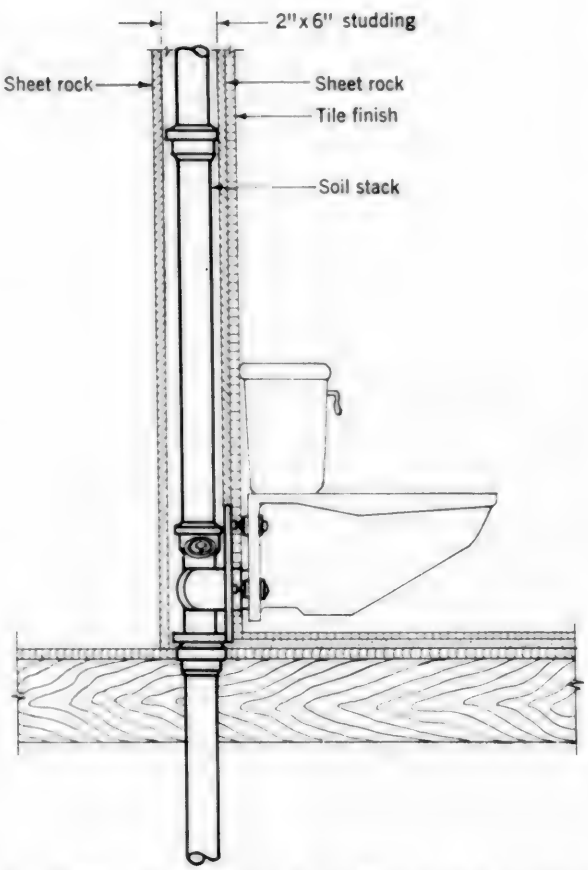


Fig. 2. Typical installation of a wall hung closet combination in a residence.

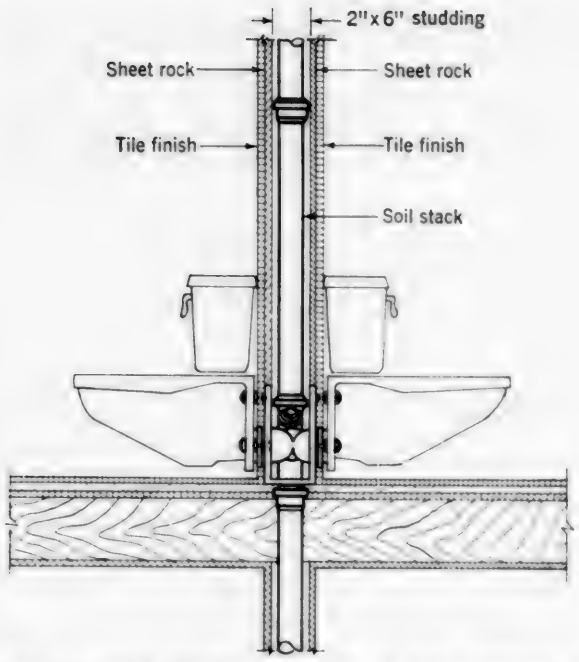


Fig. 3. Typical installation of back to back closets in a residence.

Note that the roughing is installed in a wall comprised of 2 x 6-inch wood stud framing. This includes a sheetrock and tile finish on the bathroom wall and a sheetrock finish on the other wall. The soil stack is generally of 4-inch diameter piping and extends through the roof. However, 3-inch diameter piping is also acceptable in many parts of the country. While cast iron hub and spigot piping has been indicated, for example, galvanized steel, galvanized wrought iron or copper tubing can be used with equal success. The selection of the material to be used is the responsibility of the engineer designing the system.

Cast iron hub and spigot piping has been shown in the drawings because it is of larger physical proportions than all the other materials mentioned. As such, it serves as the extreme for the amount of space needed for roughing purposes.

A manufactured fitting has been employed to receive both the outlet of the closet and, in addition, it serves as the means for supporting the closet off the floor. There are a number of different manufactured units available and many styles for this purpose. Manufactured fittings are available for caulked, threaded or sweated piping systems.

The 2 x 6-inch studding generally measures somewhat less than 6 inches. The hub of the extra heavy cast iron piping has an overall diameter of $6\frac{3}{16}$ inches, therefore it is necessary to gouge out some of the sheetrock so that the fitting will fit into the space. This is a tight fit but can be accomplished in the space allotted. Piping material of smaller proportions will fit a bit easier.

When 3-inch diameter hub and spigot piping is utilized, the pipe space should not be lessened. It should be 2 x 6-inch stud construction to offer an ease of installation; 2 x 4-inch construction will not provide sufficient space for the needs. Another reason for the 2 x 6-inch construction is that another closet is often located on the floor above, thereby necessitating the space for the installation of the proper venting for the lower closet. The water supply poses no problem because small diameter pipe is used. Manufactured fittings used for this purpose are secured to the studs and the floor.

Back to Back Installations

Quite often, residential closets are installed back to back as shown in Fig. 3. For this type installation, the 2 x 6-inch stud construction may again be used. A wide range of manufactured carrier fittings is available for the installation of back to back closets. The particular fitting illustrated in Fig. 3 is only for example.

The contractor may employ other methods of construction and materials that offer an equal or greater space. Nevertheless, for the sake of establishing a minimum space for the roughing, a space comprised of 2 x 6-inch stud construction is offered as a standard. Back to back installations are highly favored for motels because of the installation economy.

Regular Closets

The regular closet is installed in vast quantities in all types of buildings. Many applications include batteries of closets as suggested in Fig. 4 which indicates a typical method of roughing for the closets. The pipe space contains a soil stack, vent stack and cold water riser. Figure 4 shows how the horizontal drainage piping is included above the floor level, along with the branch vent and water lines.

Manufactured carrier fittings are used to receive the discharge from the closets in addition to supporting the closets. The pipe space allotted for the fixture roughing in this instance is 12 inches.

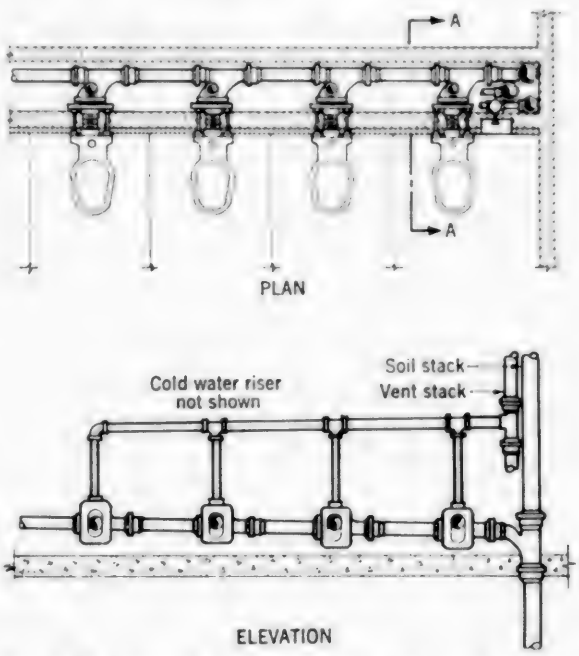


Fig. 4. Roughing for a battery of regular wall mounted water closet.

Minimum Requirements

It is the soil stack, vent stack and cold water riser that prescribes the amount of space needed for the fixture roughing. Figure 5 is Section A-A, of Fig. 4. It shows the tight grouping of the vertical soil stack, vent stack and cold water riser. The required space is 12 inches for the ease of installing this fixture roughing. This is the minimum space for containing the carrier fitting. A number of manufactured carrier fittings are available. In general, they will all fit the confines of a 12-inch pipe space. When the installation of such fittings is somewhat difficult, the fitting can be installed partially in the wall.

Exhaust ducts are usually required for interior located rest rooms. Since these ducts are generally placed in the upper portion of the pipe space, sufficient room must thus be allotted for this facility. A 12-inch space is usually ample. It is always good practice to consult with the engineer designing the ventilation system for his exact requirements. This will avoid many difficulties.

The 12-inch space is the minimum dimension to contain the roughing for wall mounted water closets. It is not practical to consider a smaller space. The arrangement of roughing shown is generally typical for all manufactured carrier fittings. An exposed type flush valve is used, for example.

For a battery of regular wall mounted water closets, a 12-inch pipe space is proposed for standardization as being adequate design for general acceptance in the industry.

Access Space for a Single Battery of Closets

In many instances there is a definite need for an access corridor to serve a single battery of regular wall mounted closets. A typical example of this provision is shown in Fig. 6.

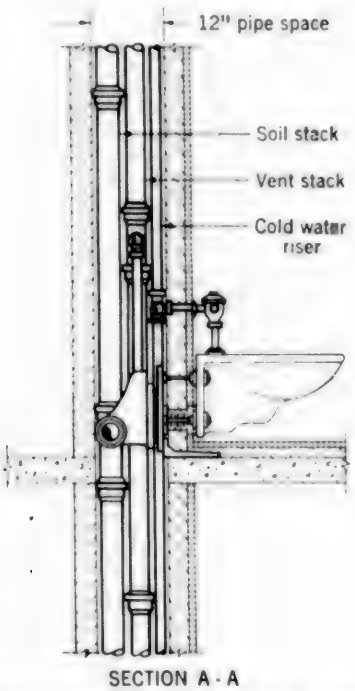


Fig. 5. Section showing arrangement of plumbing risers and roughing for fixtures.

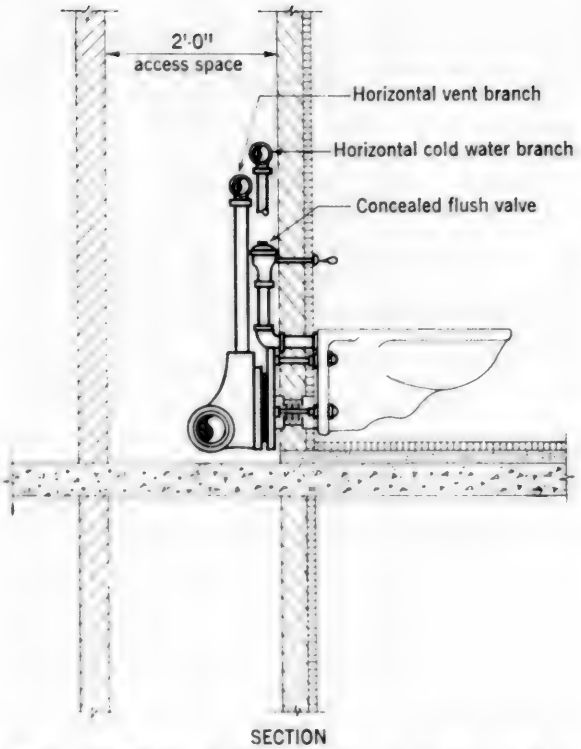


Fig. 6. Installation of roughing in an access space for a battery of wall mounted water closets.

An access corridor permits maintenance and adjustment to be accomplished with regard to concealed flush valves, without disturbing the occupants of the rest room. When an access corridor is provided it should be of ample size. Often, inadequate access corridors are provided; this limits the movements of maintenance men. Unless the space is sufficient, it does not serve a useful function. The width of the access corridor shown in Fig. 6 is 2 ft. This offers ample room for a man to pass the carrier fitting and connected drainage piping. Thus, the maintenance man has enough freedom to accomplish his task with ease. Electric lighting should be provided for good illumination in the space. When properly erected and finished, an access corridor is a clean workable area with a useful function. Contrary to popular belief, an access corridor will not offer the conditions favorable for vermin and bacteria as readily as the damp, unventilated pipe space.

The particular arrangement of concealed valves shown in Fig. 6, is just one of several arrangements which may be utilized. The cold water branch is shown as being placed above the flush valves; other locations can be followed for the installation of this branch.

When access corridors are contemplated for a single battery of water closets, it is recommended that they be standardized at 2 ft minimum, for proper space for the maintenance man.

Access Space for a Double Battery of Closets

When two batteries of water closets are involved

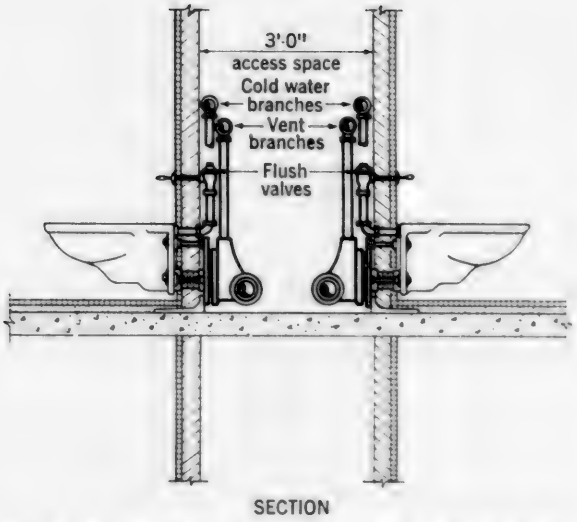


Fig. 7. Roughing in an access space for a double battery of regular wall hung water closets.

and an access corridor is contemplated, the installation might be typical to that offered in Fig. 7. Note that separate roughing has been installed for each battery of closets. Actually, this arrangement is very practical and certainly offers a cleancut access corridor. A 36-inch access corridor has been shown in this case to provide ample room for the maintenance man. It is important to mention that a minimum space of 30 inches can be utilized if the roughing is installed close to the interior walls and the carrier fitting is partially recessed in the wall construction. Whether a 30 or 36-inch space is used is the responsibility of the engineer and depends upon his particular arrangement of roughing.

The specific arrangement of flush valves shown is only for example for other arrangements can also be employed. Several different manufactured carrier fittings are available, other than the one shown. It is the engineer's choice to select the one he favors most for the application. Individual venting for the closets has been followed throughout this article and reflects maximum requirements. The installation of the roughing should always conform to local code requirements of the area in which the building is to be erected.

When access corridors are contemplated for a double battery of water closets, it is recommended that its width be standardized at 36 inches to offer the proper space for a maintenance man to perform his tasks adequately.

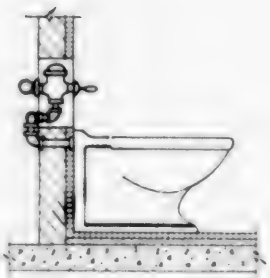
Secured Type Closets

The secured type closet is most frequently used for applications where rough treatment is expected. Thus the closets are secured to the floor and wall to prevent their being torn loose. A typical installation of the secured type closet is shown in Fig. 8. When this type of closet is employed it is always equipped with a concealed flush valve. The flush valve shown in the enlarged detail features a push button type. The flush valve can be maintained by means of an access corridor shown, which in this case is 24 inches wide. If an access corridor is required for two back to back batteries of water closets, the installation would be similar to that shown in Fig. 7. Access corridors are generally desired for secured type closets to offer a tamper proof installation.

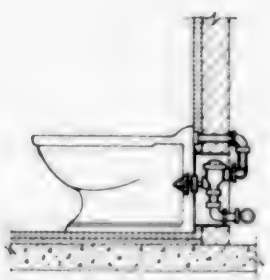
If an access corridor is not required, the roughing for a single battery of secured type closets can be installed in a 12-inch pipe space similar to that illustrated in Fig. 5. When the 12-inch space is used the flush valves can be installed similar to that shown by the two small details in Fig. 8.

One detail denotes a concealed flush valve with a handle. Access to the flush valve is gained by means of the access box shown. The detail denotes a concealed flush valve with a foot pedal. Here again, access is gained by means of the access box. The access boxes are the tamper proof type.

Each of the closets described in this article has a very definite purpose and can be installed in a number of different ways as shown in this article. Nevertheless, each installation requires a prescribed amount of pipe space in order for the proper installation to be made.



Showing how a hand operated concealed flush valve can be utilized for narrow pipe spaces



Showing how a foot operated concealed flush valve can be utilized for narrow pipe space

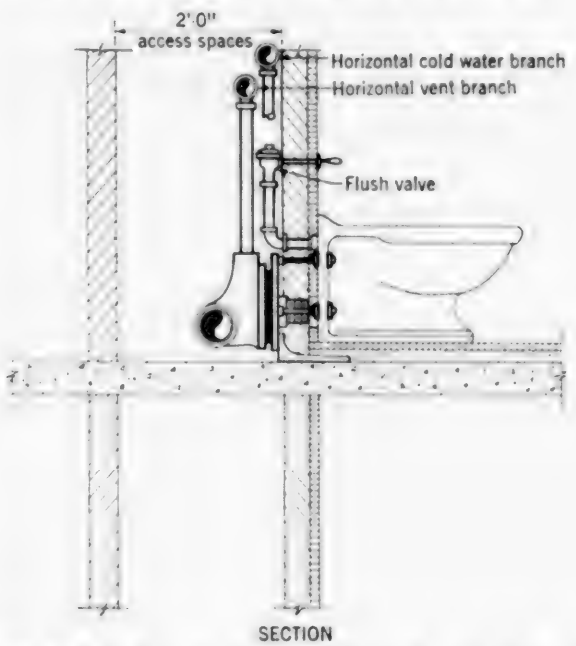


Fig. 8. Roughing in an access space for a battery of secured type closets.

NEW LITERATURE

Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.

Air Conditioning Unit

The Modine Airditioner, a self-contained, through-the-wall air conditioning unit designed to provide all-season comfort, is the subject of Bulletin 760, published by Modine Manufacturing Co., Racine, Wis. Complete ratings are included, plus cabinet and wall sleeve dimensions.

Circle **Item 1** on Inquiry Card

Control Servicing Guide

Bulletin M-88, a 20-page pocket-size servicing guide, is offered by McDonnell & Miller, Inc., Chicago, Ill. In text and diagrams, it gives the servicing story for all McDonnell boiler water feeders, low water cut-offs, and feeder cut-off combinations. Piping hookups are included.

Circle **Item 2** on Inquiry Card

Positive Leak Detection

Fast, positive leak detection for air conditioning and refrigeration service is the subject of 10-page Bulletin GEA-6827A, published by General Electric Co., Schenectady, N.Y. It describes the Type H-6 halogen leak detector, accessory equipment, and recommended operation.

Circle **Item 3** on Inquiry Card

Certified Sound Data

Certified sound data for its dual duct mixing units have been compiled and are offered in bulletin form by Buensod-Stacey Corp., New York, N. Y. Engineering Data Sheet E-29 is the result of exhaustive tests on these air units which mixed air in volumes ranging from 200 to 800 cfm.

Circle **Item 4** on Inquiry Card

Vitreous China Plumbing Fixtures

Forty-nine color chips are mounted on the inside front cover of a 28-page catalog describing the 1960 line of vitreous china plumbing fixtures made by Case Manufacturing Div., Ogden Corp., Buffalo, N. Y. Fixtures include water closets, lavatories, urinals and drinking fountains.

Circle **Item 5** on Inquiry Card

Plant Heating Problems

Plant heating problems in the metal-working industry, and the solutions offered by overhead recirculating heaters, fresh air supply heaters, and door heaters, are discussed in a 4-page application bulletin, MI-60. It is available from L. J. Wing Manufacturing Co., Linden, N. J.

Circle **Item 6** on Inquiry Card

Pump Motors

A 36-page booklet consisting of a collection of technical articles on pump motors, reprinted from "Underground Raindrops" magazine, is available from U. S. Electrical Motors Inc., Los Angeles, Calif. Subjects include lubricants, bearings, and protection; and pumping stations.

Circle **Item 7** on Inquiry Card

Packaged Air Conditioners

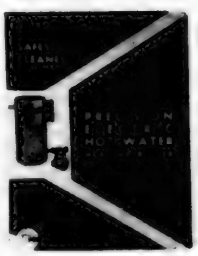
A 12-page bulletin (8825) on the subject of its packaged air conditioners is available from American-Standard Industrial Div., Detroit, Mich. Bulletin discusses performance characteristics and engineering features of this line of air-cooled and water-cooled units.

Circle **Item 8** on Inquiry Card

Propeller Fans

Complete selection data for choosing the right self-cooled motor propeller fan are contained in 20-page Catalog DB1-100, published by Ilg Electric Ventilating Co., Chicago, Ill. Included are all-around fans, high-speed fans, tube-axial duct fans, and explosion-proof fans.

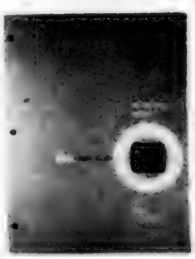
Circle **Item 9** on Inquiry Card



Electric Heating Boiler

An electric hot water heating boiler, recommended for all types of hot water heating systems and to supply hot water from 60 to 250 deg F for domestic use or processing, is described in a 4-page bulletin by the manufacturer, Precision Parts Corp., Nashville, Tenn.

Circle **Item 10** on Inquiry Card



Pipe and Block Insulation

A 6-page bulletin (Form 6472) from The Philip Carey Mfg. Co., Cincinnati, Ohio, lists pertinent data describing calcium silicate pipe and block insulation. It includes heat transmission data, physical and thermal characteristics, standard sizes and recommended thicknesses.

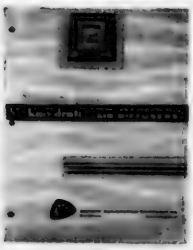
Circle **Item 11** on Inquiry Card

Gages and Controls

Pressure gages, thermometers, and control instruments manufactured by U.S. Gauge Div., American Machine and Metals, Inc., Sellersville, Pa., are described in 6-page Bulletin 3020. Included for each product is information on construction, dimensions, ranges and applications.

Circle **Item 12** on Inquiry Card

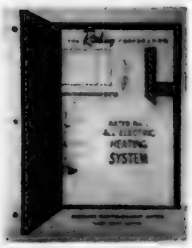
Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.



Air Diffusers

Connor Engineering Corp., Danbury, Conn., announces 12-page Bulletin K-27A which illustrates and describes its Kno-Draft "Architects' Group" of linear and rectangular air diffusers. The bulletin gives complete selection and performance data, as well as application suggestions.

Circle **Item 13** on Inquiry Card



All-Electric Heating System

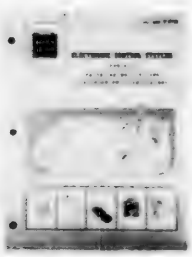
A complete line of electric baseboard and floor insert heaters, manufactured by The Rittling Corp., Buffalo, N. Y., is described in a 4-page bulletin which illustrates advantages of the Rittling all-electric heating system. Last page contains technical data, such as ratings, controls.

Circle **Item 14** on Inquiry Card

Bidirectional Windvane

Uses and specifications of a new, fast response, low inertia instrument which records both the vertical and horizontal wind directions are included in a 4-page bulletin published by Gelman Instrument Co., Chelsea, Mich. Applications include dispersion of combustion gases from stacks, etc.

Circle **Item 15** on Inquiry Card



Package Control Sets

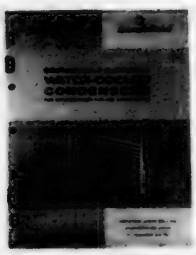
Brochure F-9754, from Barber-Colman Co., Rockford, Ill., describes its complete line of Electronic package control sets specifically designed for temperature control of all valve-type classroom unit ventilators. Control simplification is illustrated, and control cycles are discussed.

Circle **Item 16** on Inquiry Card

Compact Boilers

Its 200-hp Drum Modulatic boiler is described in Bulletin 4013 by Vapor Heating Corp., Chicago, Ill. The 2-page bulletin contains complete specifications, and describes such features as quick steaming ability, automatic modulation, compactness of size, and flexiblity of application.

Circle **Item 17** on Inquiry Card



Water-Cooled Condensers

An 8-page bulletin on mechanically cleanable water-cooled condensers is offered by Halstead & Mitchell Co., Pittsburgh, Pa. Bulletin WC-300 lists advantages of true counterflow which units incorporate for maximum heat exchange. Includes charts showing water consumption, pressure drop.

Circle **Item 18** on Inquiry Card

Liquid Level Controls

Twelve-page Catalog Section 4-A, from Magnetrol, Inc., Chicago, Ill., describes displacement-type liquid level controls for actuating pumps, valves, alarms or other functions. Bulletin includes data and diagrams which aid selection and installation of these units.

Circle **Item 19** on Inquiry Card

Packaged Water-Tube Boilers

Bulletin AD-186, from Cleaver-Brooks Co., Milwaukee, Wis., describes Springfield Type D packaged water-tube boilers for uses requiring high pressure steam. Applications include industries where large quantities of steam are required, or large-volume heating is needed.

Circle **Item 20** on Inquiry Card

Electric Motors

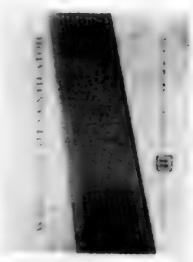
Believing that its success is based on the profitable application of an electric motor to power or produce a customer's product, Delco Products Div., General Motors Corp., Dayton, Ohio, offers Bulletin F-2005 emphasizing proper motor selection for heating, cooling, and pumping.

Circle **Item 21** on Inquiry Card

Materials Selection Data

Materials selection data for its controlled-capacity metering pumps are presented by Clark-Cooper Co., Inc., Palmyra, N. J., in 4-page literature. This summary of industry-wide information lists recommended construction materials for metering pumps handling various chemicals.

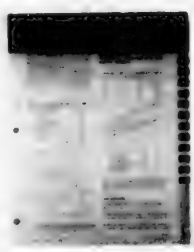
Circle **Item 22** on Inquiry Card



Unit Ventilator

Advantages and operation of the Webster unit ventilator for schoolroom heating, cooling and ventilating are described in a 14-page brochure, available from Warren Webster & Co., Inc., Camden, N. J. Also described are other components of the Webster System for Schools.

Circle **Item 23** on Inquiry Card

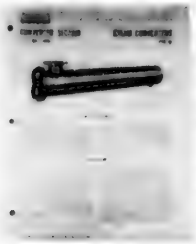


Heat Transfer Oil

A 2-page technical bulletin on Sun 21 heat transfer oil is offered by Sun Oil Co., Philadelphia, Pa. Advantages claimed for the oil include high thermal efficiency and stability, easy circulation, and low pressure operation. Bulletin gives complete information on the oil.

Circle **Item 24** on Inquiry Card

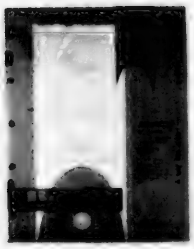
Use the prepaid yellow postcard in the back of the magazine for securing your copies of these catalogs.



Steam Converters

Dunham-Bush, Inc., West Hartford, Conn., announces File No. 1460 describing its new line of "SC" steam converters for heating radiation water with steam. The 22-page catalog includes specifications, operating data, leaving water temperature tables, and piping diagrams.

Circle **Item 25** on Inquiry Card



Light—Cool Air—Warm Air

Light, cool air, and warm air are all distributed from the same concealed fixture, the Lumi-Flo, manufactured by Benjamin Div., Thomas Industries Inc., Louisville, Ky. Fixture is described in 44-page Bulletin B which features its application to various ceiling constructions.

Circle **Item 26** on Inquiry Card

Acoustic Terminal Control Units

Acoustic terminal control units for all-air high-velocity systems are described in 36-page Catalog No. 1060, available from Carnes Corp., Verona, Wis. It includes model specifications, engineering data on system noise, and new tables of static-pressure losses and regains.

Circle **Item 27** on Inquiry Card

Water Conditioning

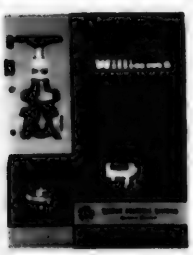
How to secure non-corrosive, non-clogging, non-precipitating water at lowest cost for commercial, industrial and home use is the subject of a 24-page brochure offered by Stiles-Karlsonite Corp., Waukegan, Ill. Applications of Karlsonite chemicals and dispensers are fully discussed.

Circle **Item 28** on Inquiry Card

Rotary Heat Exchanger

A brochure describing the Rotary-X-Changer, a rotating, air to air heat exchanger designed to recover heat from contaminated exhaust air, or to cool incoming air with exhaust air from refrigerated or air conditioned spaces, is available from Heat Recovery Corp., Newark, N. J.

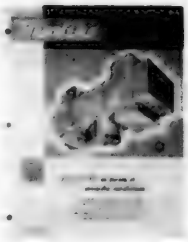
Circle **Item 29** on Inquiry Card



Valves and Controls

All information required to order D. T. Williams valves is condensed in 20-page Catalog 800-A published by the manufacturer, Detroit Controls Div., American-Standard, Detroit, Mich. Also described is a variety of pressure and temperature controls, solenoid valves and strainers.

Circle **Item 30** on Inquiry Card



Industrial-Type Unit Heaters

Gas-fired, industrial-type, vertical delivery unit heaters made by Modine Manufacturing Co., Racine, Wis., are illustrated and described in 6-page Bulletin IGV-660. Features, dimensions, performance data and specifications are presented for these direct-fired heating units.

Circle **Item 31** on Inquiry Card

Brass Plumbing Fittings

A 20-page catalog illustrating its complete line of brass plumbing fittings is offered by Harcraft Brass, a div. of Harvey Aluminum, Torrance, Calif. Catalog No. 61 also includes details on flexible supplies, stop valves, and other products manufactured by the company.

Circle **Item 32** on Inquiry Card

Registers, Grilles and Diffusers

A 72-page catalog, No. 60-AC, presents a detailed, color-coded summary of registers, grilles, diffusers and sheet metal screws manufactured for the heating and air conditioning fields by Leigh Industries Inc., a subsidiary of Air Control Products, Inc., Coopersville, Mich.

Circle **Item 33** on Inquiry Card

Electric Motor Controls

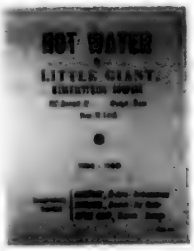
Booklet 60, a 56-page pocket catalog of electric motor controls is offered by Furnas Electric Co., Batavia, Ill. With motor rating and heater coil data arranged to make control selection easy, the booklet includes manual and magnetic starters, drum controllers, and switches.

Circle **Item 34** on Inquiry Card

Sewage Treatment Unit

An 8-page bulletin, No. 7315, from Dorr-Oliver Inc., Stamford, Conn., describes the CompleTreator, a unique unit providing complete sewage treatment in a single tank using modern, mechanized, sanitary engineering methods for disposal of the domestic waste of 150 persons or less.

Circle **Item 35** on Inquiry Card



Hot Water Applications

A 32-page catalog explains construction and advantages of coil-type hot water heaters manufactured by Little Giant Manufacturing Co., Orange, Tex. Actual installations are described which solved application problems in baptistries, swimming pools, restaurants, car washes, etc.

Circle **Item 36** on Inquiry Card

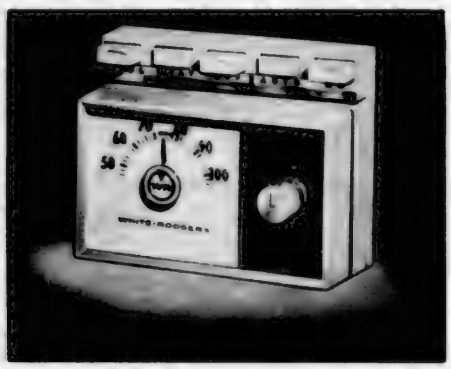
NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid yellow postcard in the back of the magazine for securing more information about new equipment and materials described in this department.

Push-Button Thermostat

A thermostat with selective push-button control of heating, cooling and ventilating is introduced by White-Rodgers Co., St. Louis, Mo. Called the Push-Button, it is the third in a contemporary-styled "Straight-Line Look" series recently announced.

Thermostat, as furnished, combines the company's D'Luxline thermostat with a sub-base with push-button switching. Eight switching combinations are



available to satisfy the requirements of all heating-cooling systems, whether controlled from a single unit or by change-over to a separate heating thermostat. Unit incorporates the clean, straight lines which are said to have proved popular in home architecture.

The manufacturer states that the PushButton, in addition to the greater visibility and easy operation of the push-button selection system offered, also has such improved performance features as sealed mercury contacts for permanent protection against corrosion, dirt and dust. The thermostat is "anticipated", to afford operating differentials as narrow as ½ deg F (heating) and 1 deg (cooling)

More Information? Circle ITEM 37 on Inquiry Card.

High-Efficiency Generators

The development of Series 33 WhirlPower package generators is announced by Iron Fireman Mfg. Co., Cleveland, Ohio. The 3-pass, low-pressure, steam or hot water firebox units employ the principles of sealed combustion and forced draft. Result is said to be efficiency in excess of 80%, low head room, and a minimum of standby loss.

Further, refractory sidewalls in the firebox, effects of draft irregularities, high stacks, ID fans, and the conventional high boiler base are eliminated.

Fired either by oil or gas or gas-oil (as desired), twelve sizes in the series are designed for commercial and light industrial installation with rated steam or hot water output of 355,000 to 2,009,000 Btu per hr or from 10.6 to 60 hp. These ratings are conservative, and all models have been thoroughly factory and field tested, the company states.

The WhirlPower unit comes completely assembled, with an enameled "wrap-around" insulated jacket and the burner mounted and wired—and at a competitive price. Factory firetest is available as an optional extra. Because the combustion system is pressure-sealed, and because the burner uses forced draft, the package generator does away with the chimney. Only a vent or stub stack—as much as a third smaller than the usual flue diameter—is needed for exhaust.

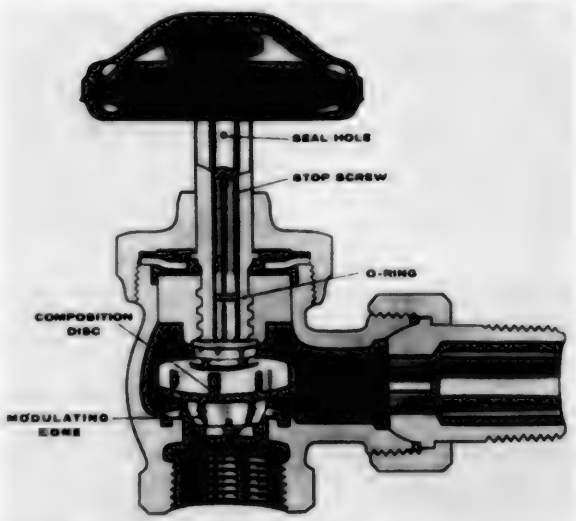
Elimination of the usual boiler base has cut head room requirements by as much as 24 to 36 inches, and a low water level (3 ft, 8½ inches to 4 ft, 11½ inches) makes it easier to install the package generator in areas with low ceilings, according to the company.

More Information? Circle ITEM 38 on Inquiry Card.

Adjustable Radiator Valve

A series of packless radiator valves with adjustable orifice permitting accurate balancing of either steam or hot water systems is announced by Marsh Instrument Co., Skokie, Ill., division of Colorado Oil and Gas Corporation.

Any required orifice adjustment is readily made

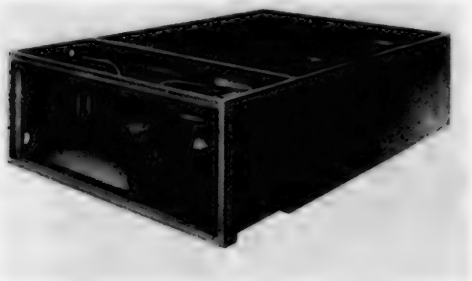


without shutting down the system or disturbing connections by removing the screw in the valve handle and inserting a screwdriver in the hollow valve stem until it engages the stop-screw as shown in the accompanying sectional illustration. The stop-screw is then adjusted to limit the valve opening to any required rate of flow: on steam, from 10 to 100 sq ft EDR; on hot water, any flow rate at any pressure.

More Information? Circle ITEM 39 on Inquiry Card.

Ten-Ton Heat Pump Offered

Indoor and outdoor heat pump sections are being offered by Carrier Air Conditioning Co., Syracuse, N.Y., for the first time in the 10-ton size. The outdoor section (Model 38AC012, illustrated) employs two large, quiet propeller fans direct driven in an upflow direction. The compressor, controls and most piping are



arranged compactly in one end of the 80-inch long unit. A low silhouette results from unit height of less than 21 inches and legs which can be set at 12 or 18 inch heights, depending on snow levels in the area. It weighs only 890 lb.

Heat and sound are both directed upward; no wind deflectors are necessary. A closely spaced wire guard protects the curious from the fans. Encased in heavy galvaneal steel with a baked-on enamel finish, the units will resist weathering for many years.

The indoor section (Model 40RT012) is an adaptation of the existing 10-ton cooling-only, fan coil unit. It can be used horizontally or vertically with ductwork or as a free-standing unit with discharge plenum. Up to three strip heaters, 15.2 kw each, may be installed within the casing of the indoor unit. The thermal expansion valve and filter drier are mounted in the factory. A fourth row in the coil acts as a sub-cooler (of condensed refrigerant) on heating cycle.

More Information? Circle ITEM 40 on Inquiry Card.

Power Roof Ventilators

A line of power roof vents with both aesthetic and functional features has been introduced by L. J. Wing Mfg. Co., Linden, N.J. Horizon Line power roof ventilators are available with a choice of three interchangeable discharges—standard straight-through, decorative straight-through, and mushroom.

Low silhouettes and attractive styling are complemented by a new color scheme: discharges are painted

a special blue for unobtrusiveness against the sky, while bases are a neutral sand-gray. Other features include a combination of magnetic damper lock, damper design, and rubber seal which makes the units chatter- and leak-proof, and light-tight. Nylon damper bearings assure quiet service and long life. Fans have aerodynamically-designed blades and are dynamically balanced. Motors are direct-connected to the fan shaft. Discharge sections are hinge-connected to fan housing for accessibility.

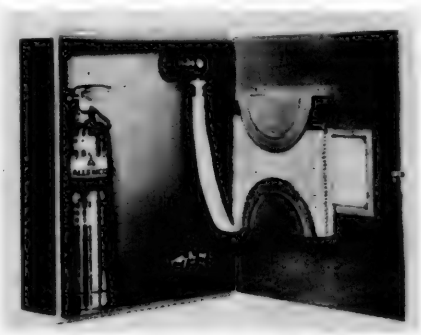
Ten fan and twelve motor sizes cover a capacity range from 600 to 51,000 cfm. Construction is all-welded heavy-gage steel with aluminum dampers as standard, and aluminum or stainless steel construction optional. Options include fusible link attachments for automatic fire ventilation, special protective coatings for corrosive atmospheres, and breather casings to isolate motors from contaminated exhaust air.

More Information? Circle ITEM 41 on Inquiry Card.

Trimless Fire Cabinets

Compactness combines with good design in four models of new Trimless Hozegard fire protection cabinets available from W. D. Allen Mfg. Co., Bellwood, Ill.

Requiring 35% less area than other cabinets, cabinets install on any plane, even in the floor. Flush mounting and elimination of trim reduce the exposed portion to the size of the door. The visible part of one cabinet, for example, is 200 sq in less than comparable models with trim, but with less equipment.



Included are knockouts for installation of 2½-inch pressure restricting angle valves and 180°-swing, foolproof hose racks mounted on the door instead of inside the cabinet. These racks accommodate from 25 to 100 ft of regular linen or cotton rubber lined fire hose, depending upon the cabinet model chosen.

According to the manufacturer, this is the first fire hose cabinet equipment to be completely Underwriters' listed. An exclusive hose clip makes the cabinet semi-automatic, perfect for one-man operation. When specified with this hose clip, the entire unit, cabinet and equipment, is 100% UL listed.

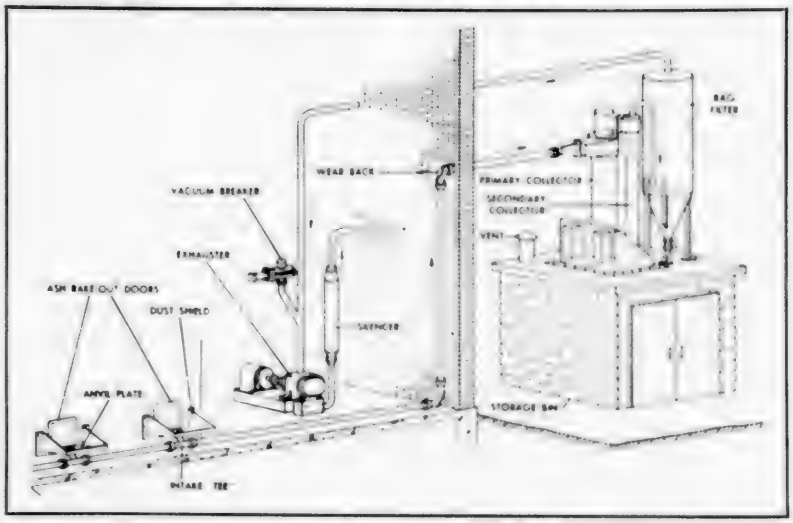
Available in steel, aluminum, stainless or bronze, cabinets are supplied with continuous hinges and chrome-plated handles. Optionals include flush steel doors, rosette ventilation openings, break glass latch shield and chrome-plated valve(s), couplings, fittings, nozzle and extinguishers.

More Information? Circle ITEM 42 on Inquiry Card.

Ash Removal System for Small Coal-Burning Plants

A packaged ash handling system developed to meet the needs of the small coal-burning boiler plant is announced by The Allen-Sherman-Hoff Co., Wynnewood, Pa. Called Econo-Ash, it is priced for plants of the type and size used by small industrial plants, hospitals, hotels, motels, schools, and institutions.

In most cases, the company states, the small plant owner can install the system with only minor structural changes required in the plant. All equipment components, except the pipe, are factory assembled, tested, and shipped ready for installation by local labor. Usually, pipe fitting is the only work actually done on the site by the supplier.



A typical system and its components are illustrated. The storage bin can be of the type shown or some other type, depending upon storage requirements and disposal methods preferred.

Using this system, ash is raked from the boiler ash pit onto a flat anvil plate. The dust shields prevent the ash from spilling out to the boiler room floor. Intake fittings in the pipeline are opened by removing a plug and the ash is raked into the opening. An optional vacuum-cleaning attachment can be supplied and an intake provided for cleaning areas around the boiler.

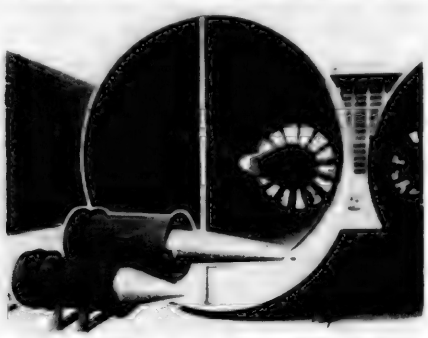
Vacuum for the air stream can be provided by either a steam jet exhauster or a mechanical exhauster. The one shown is a mechanical type. When plant steam is available at pressures of 50 psig or over, the steam jet exhauster is recommended since the steam and entrained ash can be discharged against a target plate and will then drop by gravity into the bin. No further wetting of ash is necessary to prevent dusting.

Where the mechanical exhauster is used, the air stream discharges into a primary and secondary collector and passes off into atmosphere through a bag filter and a silencer. Discharge of the collectors is intermittent, controlled by counter-weighted swing gates at the bottom of the collectors. The ash is moistened by sprays during unloading to prevent dusting.

More Information? Circle ITEM 43 on Inquiry Card.

Axial Flow Blowers

Newly developed axial flow blowers and other air handling equipment are available from Commercial Blower Div., Benson Mfg. Co., Kansas City, Mo. Units are mainly for heating, ventilating, and air conditioning applications. They are said to represent a



substantial increase in efficiency over most presently used equipment.

A blade retention system featured in its axial flow blower line is said to be extremely well received by heating, ventilating, and air conditioning engineers, according to the company. Developed for the military, the system allows each individual blade to rotate about its own hub axis, eliminating the usual bending and fatigue stresses. Blades are individually mounted on rubber pads which permits easy maintenance.

Among the other advantages of this axial flow series is its installation in the line, eliminating elbows and offsets, and its ability, in many cases, to be mounted directly to the wall or ceiling, giving additional usable floor space and avoiding foundation expense.

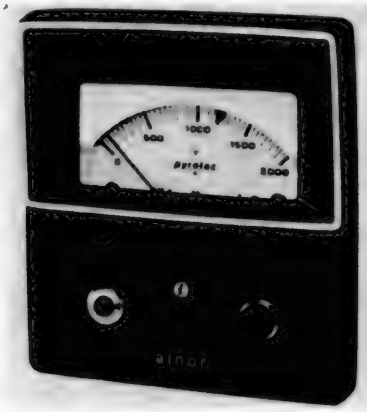
Announcement of the new products was made simultaneously with news of establishment of the division as a separate entity within the company. The company has manufactured fans and blowers for the helicopter, aircraft, and missile industries. Blading of the new blowers is similar to that used on jet aircraft engines, said to out-perform conventional three- and four-bladed propeller type fans. Among the benefits claimed are reduction of floor space requirements and sheet metal work, less noise, longer life, and lower maintenance.

More Information? Circle ITEM 44 on Inquiry Card

Excess Temperature Cutout

An accurate electric instrument which combines automatic protection against excess temperature with continuous temperature indication is offered by Alnor Instrument Co., Chicago, Ill., division of Illinois Testing Laboratories, Inc.

Called the Pyrotac, the unit is available in two models. Model N-30 will not shut off upon line voltage failure; Model N-34 will shut off in such a condition.



In addition to its cutout function, the instrument can be used to sound an alarm and/or light a signal upon excess temperature condition, thus allowing a minimum of attendant supervision with complete safety. It also can be supplied as a low temperature cutout when so specified.

Primarily intended for use in conjunction with other controllers, the unit can also serve as the only control instrument on a process requiring complete shut-down upon reaching a final preset temperature, or when operator attention is required upon completion of a temperature cycle.

The excess temperature controller is available in eleven ranges from 0-400 deg F to 0-3000 deg, as well as an environmental test chamber range of −100 to −300 deg.

More Information? Circle ITEM 45 on Inquiry Card.

Concrete Step Heater Mats

Electric concrete step heater mats, designed to clear snow and ice from concrete steps, are introduced by Edwin L. Wiegand Co., Pittsburgh, Pa.

When snowfall or freezing begins, heaters will prevent any accumulation and keep concrete steps clear and safe, the company states. No shoveling, salt or cinders are necessary for slip-proofing step surfaces.

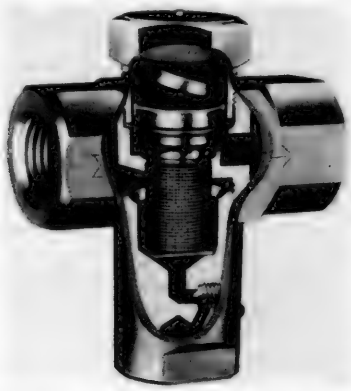
The heaters are Thermwire heating cable interwoven with lightweight galvanized mesh. They are offered in 2-step and 3-step units, heating a section 8 inches wide by 36 inches long on each step. Any combination may be used to match the number of steps requiring protection.

Mats have a rating of 42 watts per sq ft, which will clear snow and ice in almost any climate in the country. Each contains a 10-ft lead wire and a 10-ft ground wire. All cable sections are sheathed in polyvinyl with a nylon coating for extra durability. The heater units are positioned on top of the freshly poured first layer of concrete, then covered with the 1-1½ inch top layer of concrete.

More Information? Circle ITEM 46 on Inquiry Card.

Combination Steam Trap

A new component for steam lines, the No. 130 impulse steam trap, offered by Yarnall-Waring Co., Philadelphia, Pa., combines a Yarway impulse trap with strainer and blowdown valve in one body. It is designed for light condensate loads with steam pressures from 8 to 600 psi and requires only two connections.



By eliminating separate strainer and blowdown valve and their necessary fittings, the company points out, the combination trap offers potential installation savings up to 30%, reducing pipe connections by as many as six.

Trap employs the thermodynamic principle of steam trapping of the Yarway No. 30 impulse steam trap, in which valve disc snaps open to discharge condensate but closes on steam. It operates against back pressures up to 50% of steam line pressure and is furnished with ½-inch pipe connections.

The trap is recommended for steam main drips, tracer lines, platen presses, laundry and dry cleaning presses, and similar light-condensate installations.

More Information? Circle ITEM 47 on Inquiry Card.

Steam Converter

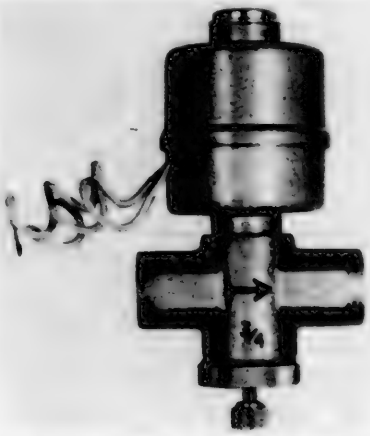
SC steam converter is offered by Dunham-Bush, Inc., West Hartford, Conn. Used primarily for heating radiation water with steam, the converter is said to offer distinct application advantages: Piping design is simplified and design work is reduced.

According to the manufacturer, this model is highly efficient for providing heating water for office space in industrial buildings. When applied to high buildings, it keeps static heads at reasonable levels as well as simplifying piping design.

More Information? Circle ITEM 48 on Inquiry Card.

Solenoid Operated Zoning Valve

Electro-Zone, a solenoid operated zoning valve for hydronic heating systems, is announced by Hydrotherm, Inc., Northvale, N.J. For economical zoning of residences, motels, apartment houses, and the like, for



both heating and cooling, it differs from motor operated valves. A single moving part is magnetically actuated and completely immersed and damped in the fluid.

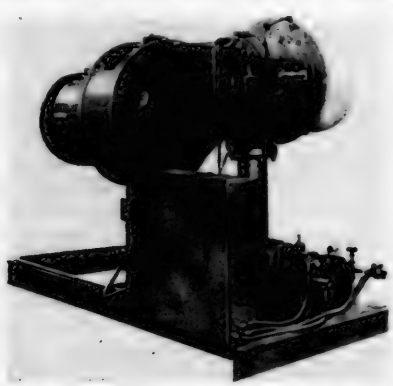
Valve works without O-rings and packings, can be used with any standard low-voltage, two-wire thermostat, and requires only two low-voltage connections. In case of power failure, an external thumb screw permits manual operation of the valve without use of tools. Compact 3 by 5-inch design permits installation within baseboard enclosures.

More Information? Circle ITEM 49 on Inquiry Card.

Long-Life Burners

A series of burners for Scotch marine, firebox, HRT, and packaged firetube boilers, as well as longitudinal drum, cross-drum, and *D* water tube boilers, is announced by North American Mfg. Co., Cleveland, Ohio.

According to the manufacturer, this series was developed with the criterion of service over many years without loss of efficiency. Units operate with gas, light



or heavy oil, and dual fuel, and are offered in input capacities of 1,000,000 to 25,000,000 Btu per hr. Dual-fuel burners change over from one fuel to the other with the turn of a switch. There is no soot, fly ash, or smoke with any of these fuels, the company states.

Each burner has 100% combustion air supplied by a centrifugal fan. Low excess air requirements and high carbon dioxide percentages are said to result in peak burner efficiency on new or old boilers. Burners may be used with negative and positive pressures.

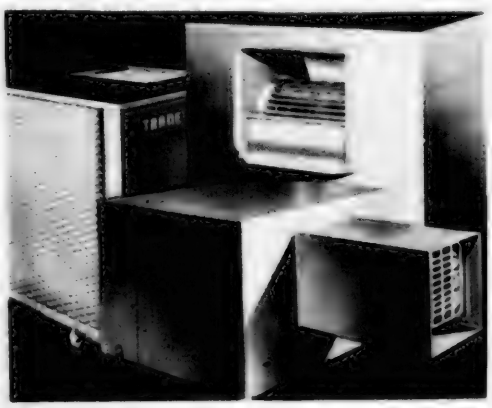
More Information? Circle ITEM 50 on Inquiry Card.

Air-to-Air Heat Pump

All-electric, air-to-air heat pumps, which both heat and cool, are introduced by The Trane Company, La Crosse, Wis., for residential or commercial applications.

Majority of the equipment is designed to be located out-of-doors (left in photo) with only the compact fan and coil unit (top right in photo) installed in attic or basement.

When used for commercial applications, such as small shops and stores, the indoor unit may be suspended from the ceiling in the conditioned space for



free delivery of air or used in connection with a system of ductwork.

For residential installation it may be installed in attics and crawlspaces, furred in above closets, enclosed by sub-ceiling partitions, or suspended openly from the ceiling in the basement.

Only electrical and refrigerant connections are needed for installation. Since only the lightweight indoor unit goes inside, no difficult rigging work is required. Outdoor coil has only two rows of tubes and the company's Sigma-Flo fins to provide an extremely large face area and relatively narrow coil width. This outdoor coil design provides adequate heat transfer area when coil surfaces are partially covered with frost, the company states.

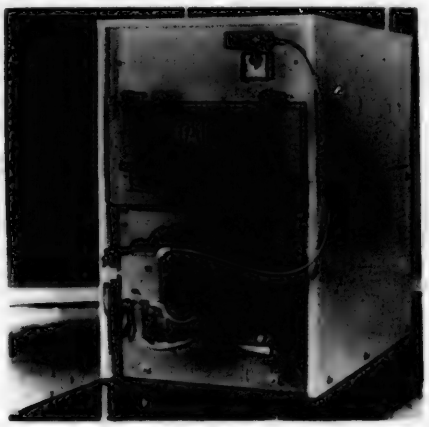
An auxiliary electric heater package (bottom right in photo) is available for use in coldest weather. The heater package is enclosed in a matching cabinet complete with its own controls and fits the indoor unit at the discharge opening.

More Information? Circle ITEM 51 on Inquiry Card.

Baseless Packaged Boiler

Series 400 baseless packaged boilers, introduced by Pacific Steel Boiler Div., Crane Co., Johnstown, Pa., are factory assembled units for oil, gas or combination oil-gas firing.

They are rated in accordance with the Testing and Rating Code of Steel Boiler Institute, Inc., for Table



3 Units, and are available in seven sizes—from 378 Mbh SBI net rating steam/water.

The units are designed for forced draft firing, with integral skid-type base, factory installed burner and refactory base, and include factory wiring and a full complement of safety controls. They meet the need for a modern, high-performance packaged unit in both new and modernization work, according to the company.

Compact, easy to install, and with a wide range of optional controls and equipment available, the boiler is said to meet the requirements of the market for large residential and small to medium size commercial installations.

More Information? Circle ITEM 52 on Inquiry Card.

Level Control Uses Less Air

A non-bleed pneumatic controller for liquid level applications, Model J-2, is introduced by Magnetrol, Inc., Chicago, Ill.

A magnet-actuated, *on-off*, snap-acting pneumatic switch mechanism, the control does not bleed to atmosphere during normal operations. This considerably reduces the amount of air required for unit's operation.

Controller has an all-stainless-steel, three-way air valve. In one valve position (high level), air is allowed to flow from the air supply line directly to the pneumatic actuator: a diaphragm valve, air cylinder, etc. In its other valve position (when liquid reaches low level), supply air is cut off, and entrapped downstream air exhausts to atmosphere.

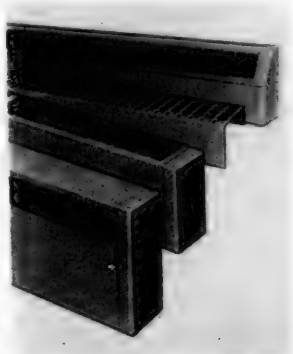
Dual magnet design gives positive snap action in both switching directions. Since valve position is always held by magnetic force, this makes this pneumatic controller highly resistant to most vibration.

Control has a high air capacity, operating against 40 psi maximum as standard and up to 100 psi with special construction. In many applications, controller and diaphragm valve can be powered by the gas in the pressure vessel where liquid level is being controlled, thus becoming a self-operating installation.

More Information? Circle ITEM 53 on Inquiry Card.

Adds Finned Tube to Radiation Line

Modine Manufacturing Co., Racine, Wis., announces the addition of finned tube radiation to its line of wall-to-wall and convector radiation products.



Available in two enclosure styles, the new line features simplified design for speedier, less costly installation. Even the longest length enclosure can be installed by one man. The standard enclosure is offered in 2, 3, 4, 5, 5½, 6, 6½ and 7 ft lengths, and the deluxe enclosure in increments of 4 inches from 24 to 100 inches. The variety of lengths available eliminates the need for cutting enclosures to fit any given lineal footage of wall surface. Enclosures can be ordered in several heights to accommodate one, two, or three tiers of 3 and 4-inch finned heating element.

Standard enclosures are offered with sloping top or flat top, each having air outlet stamped grilles in the top. Flat top deluxe enclosures are available with air outlet grilles stamped in either top or front panel.

Heating elements consist of aluminum fins and annealed copper tubing. One end of tubing is swaged to accommodate sweat connection for a reduction in installation labor and material costs.

More Information? Circle ITEM 54 on Inquiry Card.

Shower Water Saver

A low-cost flow regulator made by Taco Heaters, Incorporated, Cranston, R. I., is said to save up to 30% on water consumption at shower heads.

Easily installed by screwing in between shower head and pipe, the regulator saves the 2-3 gpm usually wasted at each shower head, the company states. Body is chrome-plated brass. Flow is automatically controlled by a rubber member in which an orifice varies in size and shape, depending on water pressure. Available for all size shower heads.

More Information? Circle ITEM 55 on Inquiry Card.

(Continued on page 116)

SOFTITE® BY WHEELING

...bend it

...hem it

...scribe it

...punch it

...form it

...notch it

...lock it

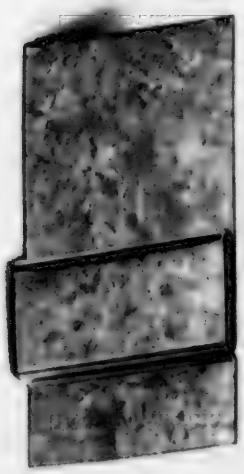
...snip it

...draw it

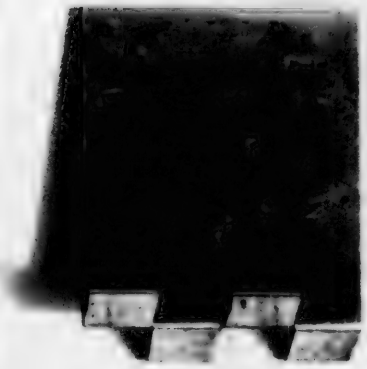
...saw it

...stamp it

...shear it

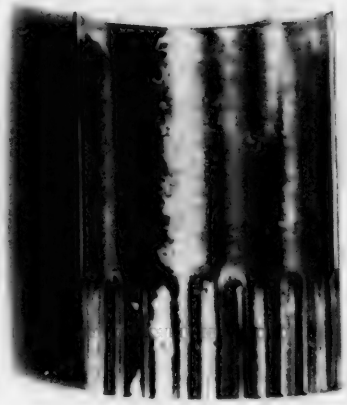


...seam it

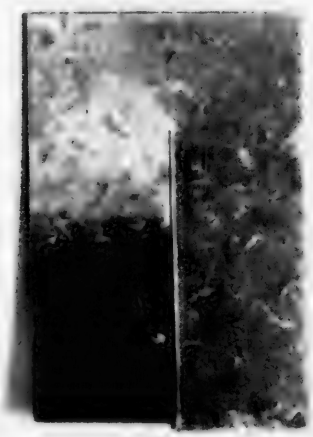


...dovetail it

...weld it



...crimp it



...slit it

...wire it

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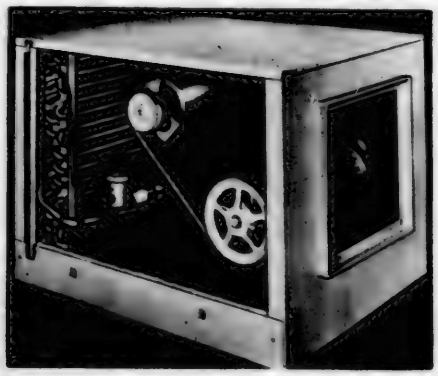
Steel

(Continued from page 113)

Split Conditioning Systems

Split system air conditioning installations introduced by Crane Co., Chicago, Ill., are suited to homes and commercial installations where economical auxiliary cooling is desired.

The air-cooled systems are adaptable to a wide range



of installations, regardless of the type of heating system used. For warm air systems, a cooling coil is installed in the furnace plenum or ductwork, utilizing the existing blower for distribution of conditioned air. For homes and buildings using hydronic heating, an air handling unit with integral blower and motor is available.

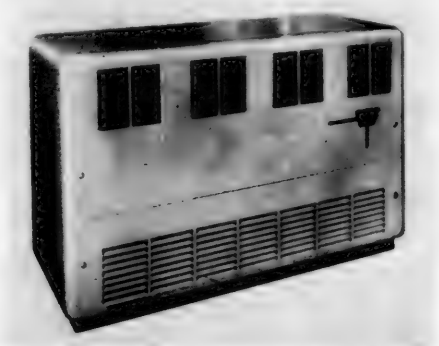
No valuable floor space is wasted because the evaporator coil can be concealed in attic space or existing ductwork. The remote, air cooled, condensing unit is located outside the building, thus eliminating disturbing noises and vibration within the building.

More Information? Circle ITEM 56 on Inquiry Card.

Electric Console Unit Heaters

Advanced engineering design, modern styling and application flexibility are said to be outstanding features of the new line of Chromalox electric console unit heaters manufactured by Edwin L. Wiegand Co., Pittsburgh, Pa.

These heaters are designed for installation in all types of buildings—in lobbies, entrances, corridors,



reception rooms, offices, stairwells—and for many other types of space heating applications.

The basic unit is available in free standing, semi-recessed or full recess models which, in turn, can be mounted in floor, wall or ceiling positions. These models, together with a variety of inlet and discharge air arrangements, provide almost limitless application flexibility.

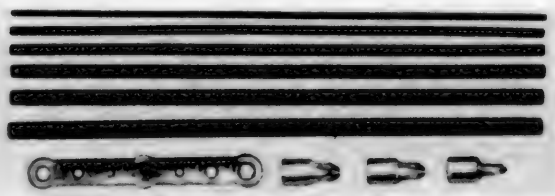
Built-in automatic temperature controls maintain desired comfort level by closely coordinating operation of fan motor and heating elements. Heating capacities range from 8,200 to 102,500 Btu per hr. Automatic night temperature setback operation is also available.

More Information? Circle ITEM 57 on Inquiry Card.

For Servicing Fans

Solving a long time problem in reaching remote set screws in fan hubs, Watsco, Inc., Hialeah, Fla., introduces combination magnetic hex wrench and Phillips-type screwdriver set.

Included are six extra long magnetic hex wrenches each measuring 9 inches in length; three hardened screwdriver tips of standard Phillips-type sizes and a master handle.



The hex wrenches are made of fine tempered, chrome vanadium steel in sizes 3/32, 1/8, 5/32, 3/16, 7/32, and 1/4 inch, each magnetized to enable the user to easily recover any set screw that may have fallen in a remote place.

The hardened screwdriver tips are standard Phillips-type sizes, No. 1, No. 2 and No. 3, and are designed for snap on to either end of the 1/4-inch hex wrench

Packaged in a hinged steel box, total weight only 20 ounces, the entire set is easily carried, instantly available when needed. All components in the set are also available individually.

More Information? Circle ITEM 58 on Inquiry Card.

Sprinkler Alarm Control

Type J7X-5355 is added to its line of pressure controls by United Electric Controls Co., Watertown, Mass. This compact unit is designed to control electric motor and alarm circuits in sprinkler systems.

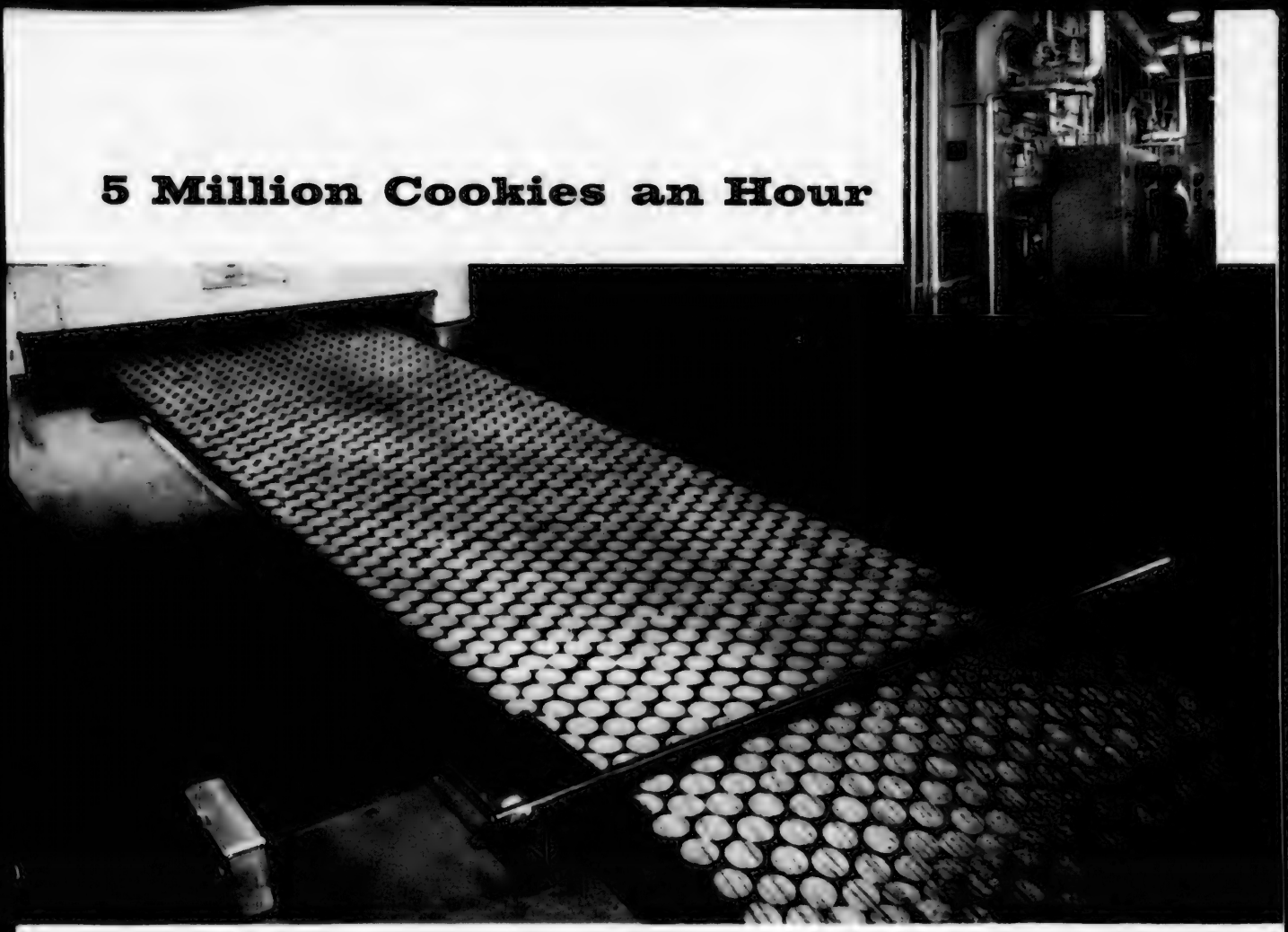
Control is FM approved and UL listed and may be used with alarm check valves, dry-pipe valves, and special water control valves to actuate an electric alarm when the valves operate.

Pressure settings are easily made by an internal adjustment nut over a range from 0 to 20 psi. Proof pressure is 300 psi; maximum pressure, 500 psi.

More Information? Circle ITEM 59 on Inquiry Card.

(Continued on page 118)

5 Million Cookies an Hour



Nabisco relies on B&W Package Boilers to supply heat for buildings and steam for all of their process requirements where giant ovens produce 177 million pounds of bakery products annually.

In Nabisco's $15,000,000 plant at Fair Lawn, N. J., three B&W Package Boilers are used to heat the plant, and to supply steam for process equipment. Operating at 130 psi and 338 F, the three oil-fired boilers deliver a total of 84,000 lb of steam per hour. Each of the plant's ovens are the length of a football field and these immense bake-ovens process up to 5,600,000 cookies an hour! Needless to say, dependable process steam supply is a must in this massive baking operation. That's why Nabisco selected B&W Package Boilers to provide the needed steam.

Dependability, however, is only part of the story. Budget-minded Nabisco management has found the cleanliness of operation, high fuel economies, flexibility, rapid response to demand, and maximum capacity in minimum space afforded by B&W Package Boilers equally attractive features. They also appreciate the assurance that B&W's nationwide service organization will be promptly and economically available if needed—at *any* time during the life of the boilers.

Supplying heat and process steam for a modern baking plant like Nabisco's is further evidence in action of dependable steam generation by B&W. Whatever *your* steam requirements . . . whatever your most economical fuel, B&W has the boiler best suited to your application. Your local B&W representative has all the facts on your area. Call him soon. **The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.**

B&W—THE NATION'S LEADING MANUFACTURER OF INDUSTRIAL BOILERS

G-979A-18

B&W THE BABCOCK & WILCOX COMPANY

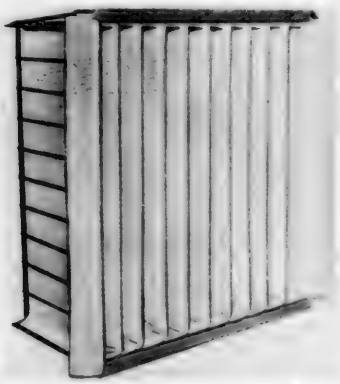
BOILER DIVISION

(Continued from page 116)

Deep-Pleated Disposable Filters

A family of deep-pleated filters is developed by Farr Co., Los Angeles, Calif., to operate at the lowest pressure drop and provide the highest efficiency and dirt holding capacity, according to the company.

The HP (High Performance) series of disposable media filters is comprised of three interchangeable



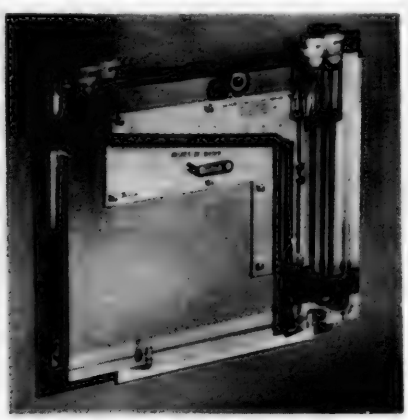
cartridges in three atmospheric efficiency ranges: Model HP-100 is in the 85% range; HP-200, in the 95% range. The HP-2 cartridge is in the 35% range.

Folding media in the first two models consists of reinforced fine glass fibers. The HP-2 media is reinforced non-woven cotton fabric. According to the manufacturer, ease of installation and disposal in servicing flat or vee banks, combined with less storage space and cartridge replacement time are features which add to the economy of its installations. Filters operate at positive efficiency without power, water, or drain facilities. Cartridges are flame proofed.

More Information? Circle ITEM 60 on Inquiry Card.

Unbreakable, Accurate Manometers

A line of inclined-vertical manometers designed for use with pitot tubes and in flow measurements is an-



nounced by F. W. Dwyer Mfg. Co., Michigan City, Ind. Instruments are available in single and double column style, stationary or portable, in various ranges up to 23 inches of water. They are accurate within plus or minus 1%. Fabricated from solid blocks of clear acrylic plastic, they are virtually unbreakable.

Fixed scales are polished chromium, permitting accurate alignment of the fluid meniscus with its image to eliminate parallax error. Split aluminum inserts and machine screws hold the scales and the other accessories securely to the instrument, eliminating stripped threads or other damage to the plastic.

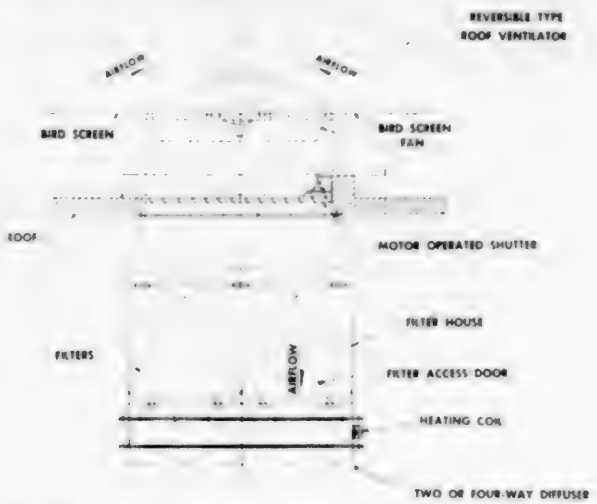
Only ground glass spirit levels are used, for maximum accuracy and sensitivity. Rapid shut-off type molded nylon gage connectors are standard—other styles optional. Portable models include magnetic mounting clips as well as standard flat surface leveling mounts. Metal carrying cases for the portable instruments are also available.

More Information? Circle ITEM 61 on Inquiry Card.

Air Intake Units

A versatile line of vertical discharge air intake units for use in replacing air removed by the operation of exhaust systems is available from Hartzell Propeller Fan Co., Piqua, Ohio.

Versatility of the line is made possible by its assembly of standard components to meet job requirements. Shutters, steam coil, filter house and outlet dif-



fusers are added as needed to the basic low silhouette, black-out type roof ventilator fan housing.

Four basic units give a capacity range of from 4,000 to 36,000 cfm. Where tempered air is required and a steam coil used, Btu capacity (at 5 lb steam pressure) ranges from 380,000 to 2,642,000 Btu per hr.

Schematic drawing shows position of motor-operated shutter, filter house, heating coil and diffuser—the optional components which are included as necessary to meet specific job requirements.

More Information? Circle ITEM 62 on Inquiry Card.

(Continued on page 120)

whether it is

AIR CONDITIONING

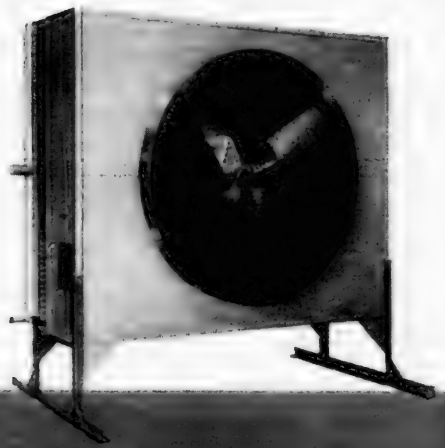
OR REFRIGERATION

look first to...

McQuay AIRCON

AIR COOLED CONDENSERS

Horizontal Air Flow AIRCON



13 SIZES
8 TO 85 TONS
IN A SINGLE UNIT

Vertical Air Flow AIRCON

When water is a problem, look first to these popular Aircon air cooled condensers. Aircons are suitable for either refrigeration, air conditioning, or both. These heavy duty condensers are built to take it, and are available in horizontal as well as vertical air flow models where their low profile is often desirable. They are available in 13 sizes from 8 to 85 tons in a single unit. Multiple units, of course, enable any desired capacity to be attained, and you can always depend upon McQuay Aircons to do the job—the way you want it done.

Consult your local McQuay representative, or write McQuay, Inc., 1619 Broadway St. N. E., Minneapolis 13, Minnesota.

rigid, heavy gauge construction for durability and low noise level

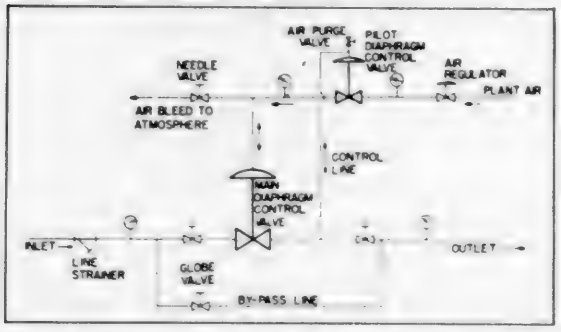
McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

(Continued from page 118)

Pressure Reducing Valve

Available in 4- and 6-inch sizes from OPW-Jordan, Cincinnati, Ohio, are sliding gate and plate pressure reducing valves, air operated, with capacities to 50,000 lb steam per hr or 2,500 gpm of water.



Used to reduce pressure wherever large capacities, accurate control, and tight shut-off are required, the system is suitable for pressures to 250 psi and temperatures to 500 deg F.

Main valve is available in ductile iron and cast iron, flanged. Sliding gate and plate seats are lapped to lightband flatness, the company says. Seats are self-cleaning and self-lapping to give tight shut-off and minimum maintenance.

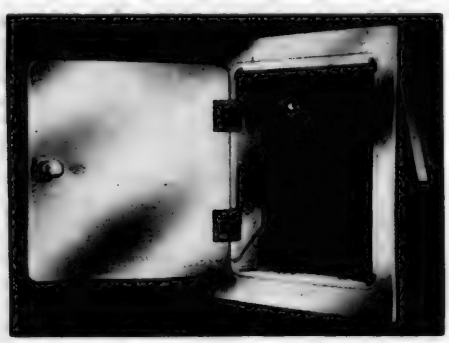
All items in the sytem illustrated are available from the company, or just the main and pilot valves may be purchased, as desired.

More Information? Circle ITEM 63 on Inquiry Card.

High-Quality Access Door

A high-quality access door, called Inspecdor, is introduced by Plumbing Products Div., Zurn Industries, Inc., Erie, Pa.

This product, according to the company, is being produced to meet the demands of designers and builders for an access door that combines high-quality con-



struction with a neat, trim appearance wherever mechanical or electrical outlets are necessary.

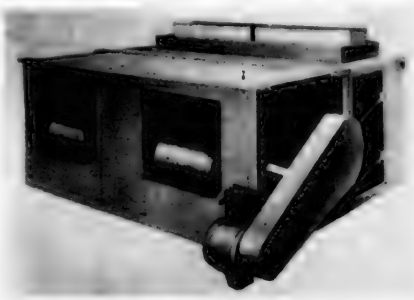
Access doors are made of heavy-gage stainless steel or chrome-plated steel (for use in marbled, tile, or similar areas) and perma-coated steel (for painted areas). There are no unsightly projections to break the smooth, clean appearance of ceiling and wall surfaces, because Inspecdors feature a flush frame and hidden hinges. The door itself has rounded safety corners and a protective cylinder lock. Door swings open a full 180° for easy access to valves and fittings.

More Information? Circle ITEM 64 on Inquiry Card.

Air Handling Units

A line of central station heating, ventilating, and air conditioning units is announced by Airtherm Mfg. Co., St. Louis, Mo. Called Centralaire, units are available at ratings from 400 to 30,000 cfm for cooling, heating, ventilating, humidifying, dehumidifying, filtering, and air conditioning.

According to the manufacturer, the units match fan and coil face area to the system by offering two fan sizes and three coil sizes for each model. In addition, the units feature sectionalized design, channel frame



construction for high strength and light weight, and smooth appearing, flush mounted furniture steel cabinets, the company states. All metal surfaces are phosphatized and finished with metallic bronze enamel.

Among other features are: choice of internal or external face and bypass section, combination mixing box and filter section (or filter section, only) drain pan under coil and blower section in all air conditioning units, complete selection of filter types, vari-pitch V-belt drive, and internal bearing arrangement for flush-against-the-wall installation.

More Information? Circle ITEM 65 on Inquiry Card.

Plastic Pipe

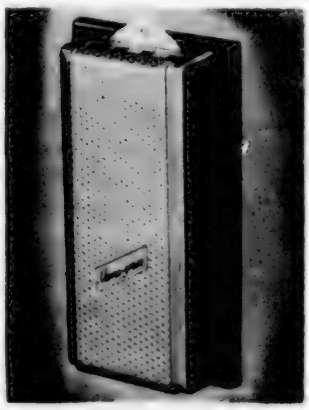
Skyline Industries Sales, Inc., Titusville, Pa., has added a high density polyethylene pipe to its line. Called Ultra-Line, it is claimed to excel in tensile strength, to possess excellent resistance to chemicals, and is recommended for service in temperatures up to 150 deg F.

Both the interior and external surface of the pipe have a very smooth finish and a greater resistance to ageing and abrasion than other polyethylene pipes, the manufacturer states. Made from Allied Chemical resin, it is backed by a 5-year warranty and is stocked in lengths up to 400 ft and in 75 and 100-lb working pressures.

More Information? Circle ITEM 66 on Inquiry Card.

Line Voltage Thermostat

A line voltage cooling thermostat that is unaffected by altitude and humidity has been developed by C. E. Armstrong Co., Gladstone, Ore. It is said to be extremely accurate from 0 to 300 deg F and is offered in ranges of 50-deg increments.



Called Mono-Gram, thermostat provides remote thermostatic control for operating cooling systems in factories, warehouses, and in areas of high humidity, as walk-in coolers, florist cases and other areas where precise temperature adjustment is desirable, and to prevent equipment such as transformers from overheating. Cost of installation is said to be little more than for manual control devices.

Thermostat is actuated by a rugged bi-metal thermal element used because of its extremely high sensitivity to temperature change, the company states. A positive snap action micro-switch provides fast on-off action, prevents arcing, chatter, radio and TV interference.

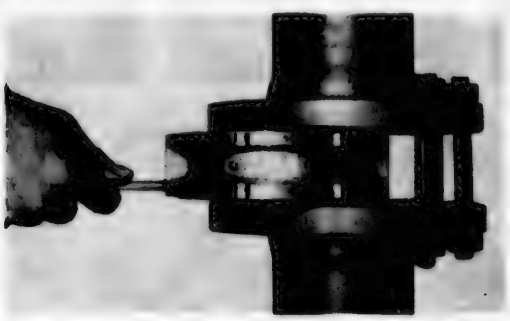
Fitting all standard outlet boxes, thermostat is available in a full range of capacities, including 15, 20 and 25 amp single and double line break, and a 2-step modulating 30 and 40 amp.

More Information? Circle ITEM 67 on Inquiry Card.

Check Fits Between Flanges

Availability of its Duo-Chek valve that fits between flanges is announced by Mission Valve and Pump Co., Houston, Tex., a subsidiary of Mission Mfg. Company.

Valve fits both ASA 150 and ASA 300 flanges in sizes 4 through 12 inches. In sizes 2 and 3 inches, one valve fits ASA 150, 300, and 600 flanges. It is also available in sizes through 36 inches. It is particulary adaptable to process, refrigeration, heating, and ventilation work, the company says.



According to the manufacturer, the valve averages 90% smaller than any other check valve of the same pipe size, and its light weight and compact size result in lowest possible installed cost. It has a resilient seal which withstands all pressures. Sealing material is molded into a groove in the plate, making an O-ring type seal. Spring closure permits positive seating without slamming and opening with only a few ounces of pressure on the upstream side.

More Information? Circle ITEM 68 on Inquiry Card.

Fountain Converts to Cooler

A line of drinking fountains that can be converted to water coolers is offered by Division DF, Sunroc Corp., Glen Riddle, Pa. Conversion is accomplished without disturbing initial installation and plumbing hook-up.

A suggested application is its installation in schools with limited budgets. After installation, a Parent-Teacher or other civic group may furnish the refrigeration package.

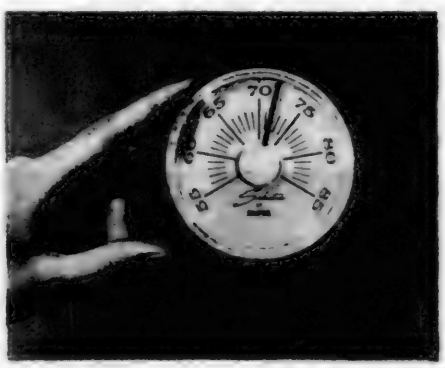
Both wall-hung and floor models are offered.

More Information? Circle ITEM 69 on Inquiry Card.

Combination Wall Control

A combination wall control for electronic modulation systems employed on gas furnaces is now available from Maxitrol Company, Detroit, Mich.

The Selectra modulation system, which was introduced to the home heating market last year, required use of a separate thermostat to act as an end switch. This need for the separate control has now been eliminated; the thermostatic function has been incorporated in a new Selectrastat wall control.



The appearance of this new control is identical with that of its predecessor. However, added to the modulation control (with a tiny thermistor to sense 1/10 degree temperature variations, plus a tempertaure-setting dial) is a bi-metal thermostat. The bi-metal thermostat contains a spark-quenching design which produces mechanical snap action and magnetic spark blow-out.

More Information? Circle ITEM 70 on Inquiry Card.

(Continued on page 124)

New "standards"

Also available in electronic dual-element type

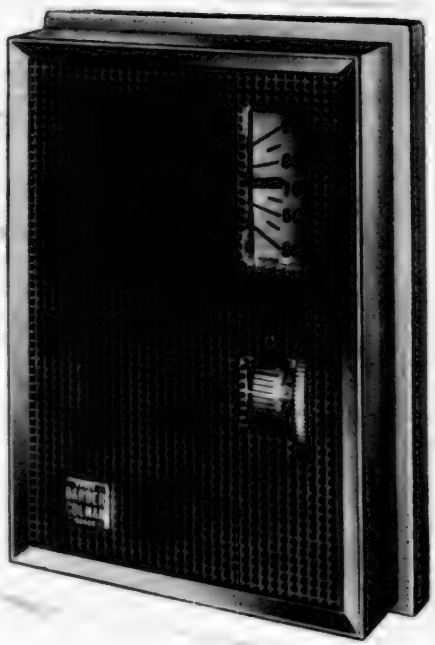
Typical subbase neatly accommodates control switches

Accessory kit modifies thermostat to prevent tampering

Literature

in room thermostats

Broad new line of room thermostats includes standard catalogued variations to meet every requirement



Now a broad new line of versatile room thermostats is offered by Barber-Colman to meet every requirement. You can select the exact thermostat you need from a very wide range of basic styles—all are *standard* items—all are *completely catalogued* for your convenience.

24-120-240 volts. There are light-duty models for on/off control of relays, solenoid valves, and other pilot-duty applications—medium-duty models for control of heaters, motors, and other heavier load applications. Both types conveniently operate on low or line voltages (24, 120, 240) as required. Room microtherm models provide proportional control of Barber-Colman motor-operated valves, damper motor operators, and sequence controllers.

Night depression—heat anticipation. All thermostats in this versatile new line are available with resistance heaters for night depression or heat anticipation. Perforated faceplates permit unrestricted air circulation for maximum temperature sensitivity. A clear plastic cover protects the wide-scale temperature dial. Graduations are easy to read—there is a mark for each degree. A precision bimetal thermometer clearly indicates a room temperature from 50° to 90°. The sturdy bakelite base has large screw-type terminals. Standard finish is champagne gold, but a polished chrome cover frame with a bronze perforated metal insert is also available.

Add-on construction. Easily added matching subbases that neatly accommodate a wide variety of manual switches contribute to the versatility of the new line. The switches are SPDT types with or without center "off" position for such functions as: switching from heating to cooling control, day-to-night control, or automatic to full "on."

Cover kits. A lock cover screw kit will modify these thermostats to prevent tampering. Guards are available for protection from external damage in auditoriums, gymnasiums, and factories, as well as special fittings for use with exposed conduit.

Next time you specify room thermostats, select the exact models you need from the broad new Barber-Colman line. Be assured of quality, installation ease, and sensitive, reliable operation.

Ask for Bulletin F-10201. Call your local Barber-Colman Automatic Controls office or write:

BARBER-COLMAN COMPANY

Dept. J, 1302 Rock Street, Rockford, Illinois

(Continued from page 121)

Damper Controls Baseboard

Base-Ray Damper, introduced by Heating and Cooling Div., Burnham Corp., Irvington, N. Y., is a way to control baseboard heating. Meeting FHA requirements for series loop installations, and compatible with new or existing installations, it eliminates shut-off valves, permitting control of individual rooms. It

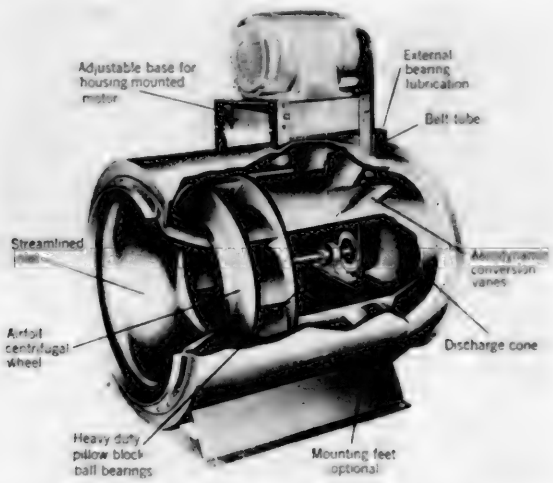
is opened and closed with the flick of a finger. Photo shows baseboard with damper opened and closed.

Damper is made of heavy-gage steel, has no chains or knobs, and is held closed by its own weight. Damper assembly consists of damper and damper hinges only. Designed to fit all Base-Ray models, it is available in 4, 5, 6, 7, and 8-ft lengths.

More Information? Circle ITEM 71 on Inquiry Card.

Straight-Line Centrifugal Fan

Introduction of the Centriline fan, Series 200, was made by Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Mass. A straight-line flow centrifugal fan, it permits air conditioning and air handling fan installations in less than one-half the space previously required, the company states.



Combining the advantages of airfoil-bladed centrifugal fan performance with the space-saving features of straight-line air flow, the fan is said to provide the opportunity to utilize smaller areas in both commercial and industrial buildings that were formerly considered waste space. Compact design permits hanging the fans from the ceiling, mounting them on the wall, or stacking them one above the other, saving valuable floor space.

By shaping the housing to provide straight-through, rather than the conventional right-angle flow, as in scroll-type units, physical sizes have been reduced up to 50%. The fan exterior looks like an axial fan. Newly developed vanes minimize noise.

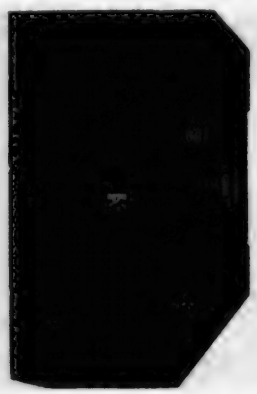
Rated according to the same AMCA classifications as are scroll-type fans, the fan is available in six sizes with wheels from 27 to 44½ inches in diameter. Heavy, all-welded steel casing is rigidly braced internally to carry the weight of the heaviest motors, allowing mounting on the housing itself or on an integral vibration base. Since inlet and outlet diameters are the same, one size duct may be used.

More Information? Circle ITEM 72 on Inquiry Card.

40, 50 Ton Self-Contained Units

New 40 and 50-ton self-contained air conditioning units (Models 41EE044 and 41EE054, photo illustrates both) are offered by Carrier Air Conditioning Co., Syracuse, N.Y., both with and without water-cooled condensers, giving the option of air-cooled or evaporative operation.

Three complete refrigerant circuits in each unit are said to give excellent capacity control. The three



Carrier shell and tube condensers are connected to provide single inlet and outlet connections to a cooling tower, thus cutting field labor. The pre-wind electrical center prevents more than one compressor from starting at the same time. Removable panels on all four sides permit access for service. Crankcase heaters are standard on the condenserless models and both types can be weatherproofed for outdoor use.

All branch circuit protection is furnished by circuit breakers in the unit and only a single electrical power connection need be made. No fused disconnects are required, simplifying installation and reducing cost.

More Information? Circle ITEM 73 on Inquiry Card.

(Continued on page 126)

Now . . . pull the fan wheel or motor while DeBothezat® Bifurcator® Fan remains in duct.

Not just an access door. Half the entire cone comes off.

Speed up inspection . . . slash maintenance and downtime costs.

This removable cone design is an exclusive feature found only on DeBothezat Bifurcator Fans.

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American Machine and Metals, Inc.
East Moline, Illinois

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FGO *Six models for gas and light oil, in capacities to 3,500,000 BTU.*

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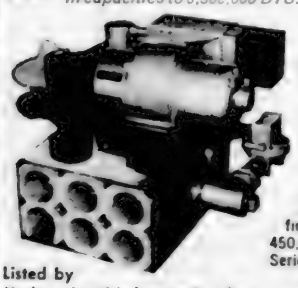

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BFGG—For all gasses and Liquefied Petroleum. A complete line from 450,000 to 20,000,000 BTU. The BFGG Series incorporates many of the product features of the famous FGO Series.

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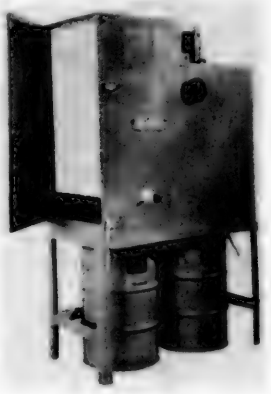
Power Flame®
Division, Inc. / 1203 MAIN ST. GRANDVIEW, MO.

(Continued from page 124)

Separator Type Dust Collector

Announcement of a 1200-cfm Master Model 1200 dust collector is made by The Kindt-Collins Co., Cleveland, Ohio.

This new separator type air cleaner is adaptable to individual or group machines producing wood, metal or plastic dust, chips or shavings. The number of machines that this dust collector will handle satisfactorily can be increased substantially by using the company's Ventomatic air control valves.



Machine has two 55-gal drums for the collection of filtered-out material. One drum is in reserve while the one in service is being filled, making it easy to dispose of dust, shavings, etc., without stopping machines. Drums can be changed in seconds, the company states.

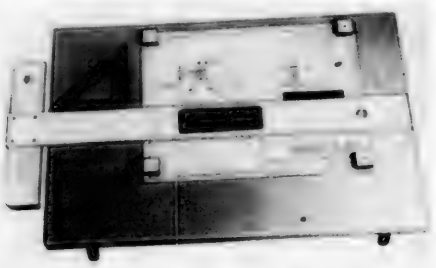
A 3-hp motor furnishes ample suction capacity through a 7-inch inlet. Filter bags, 14 in number, are made from heavy flame- and mildew-proof cloth, through which cleaned air is returned to the room without heat loss. Machine is 102 inches high.

More Information? Circle ITEM 74 on Inquiry Card.

Magnets Hold Paper to Board

Lightweight, all-metal, desk top drafting boards are offered by J. E. Menaugh Co., Chicago, Ill., with contact magnets supplied with each.

Thumb tacks, which damage board surfaces and



tear tracing paper, are not used. While drafting tape may be used, if preferred, the magnets supplied with each board are said to hold tracing paper firmly in place without tearing.

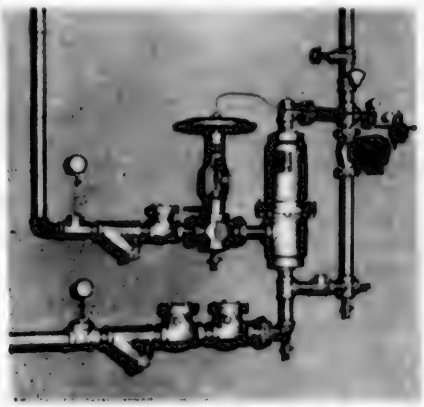
Boards are available in three sizes: 9 x 12, 12 x 18, and 18 x 24 inches. The smallest fits easily into a brief case, the company states. The board's heavy rubber cushioned feet prevent damage to furniture. Legs fold to 1-inch depth for easy carrying and storing.

More Information? Circle ITEM 75 on Inquiry Card.

Instantaneous Water Heaters

The recent introduction of Pick instantaneous water heaters for low-pressure steam has opened a vast new market, according to Pick Manufacturing Co., West Bend, Wis.

Every advantage of the company's high-pressure steam models is found in all low-pressure sizes, which



operate on pressures as low as 5 lb. Storage tanks are unnecessary, only three pipe connections are required, and heater can be mounted out of the way on a wall.

Temperature is controlled within 3 deg F accuracy, the company reports, regardless of continuous or the severest start-and-stop operation. Steam demands are at absolute minimum because only as water is drawn does the mixing of steam and water take place in the mixing chamber.

More Information? Circle ITEM 76 on Inquiry Card.

Quick-Connect Coupling

Rigid-Line quick-connect, quick-disconnect coupling, designed solely for permanent piping applications, is introduced by Snap-Tite, Inc., Union City, Pa.

No flexible hose is required on either end of the coupling, which seals tight on the user's choice of rubber gasket. Used in pairs, it is said to facilitate

quick addition or removal of relief, flow control or check valves, gages, pumps or meters in permanent pneumatic, hydraulic or other fluid flow lines.

Coupling is available in ½ and 1-inch ID sizes with a choice of three metals: cadmium plated steel, anodized aluminum, or Type 316 stainless steel.

More Information? Circle ITEM 77 on Inquiry Card.

For Air Conditioning

Thermal expansion valve set accurately in less than a minute with the . . . . .

Alnor PYROCON®

Eliminate the clumsy, slow thermometer method of determining temperatures in the system.

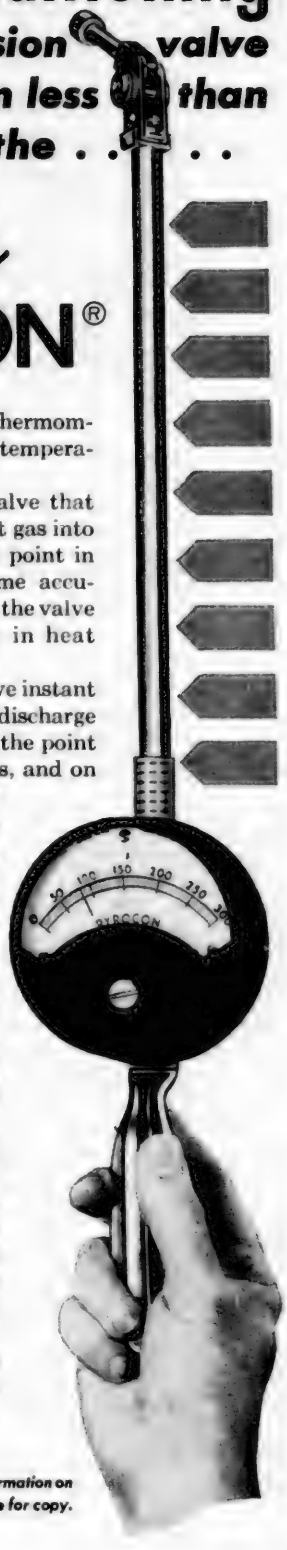
The thermal expansion valve that meters the flow of refrigerant gas into the cooling coil is a critical point in any cooling system. Extreme accuracy is necessary in adjusting the valve to obtain peak efficiency in heat absorption.

The Alnor Pyrocon will give instant temperature readings at the discharge side of the expansion valve, the point where heat absorption starts, and on the outlet of the coil where the total heat absorbed is registered. The temperature differential enables the operator to make a perfect setting of the expansion valve immediately.

Pyrocon model 4000 with a temperature range of 0-300° F. is recommended. Price with case including shielded thermocouple tip $125.00 f.o.b. Chicago.

The Pyrocon is also ideal for testing steam traps, balancing hot water systems, locating hot water pipes in cement floors, testing panel heating in walls, floors or ceilings, or making any surface temperature reading.

Other models with ranges up to 0-2000° F. and sub-zero ranges also available.



Bulletin No. 4257 contains complete information on the full line of Pyrocon instruments. Write for copy.

Alnor INSTRUMENTS

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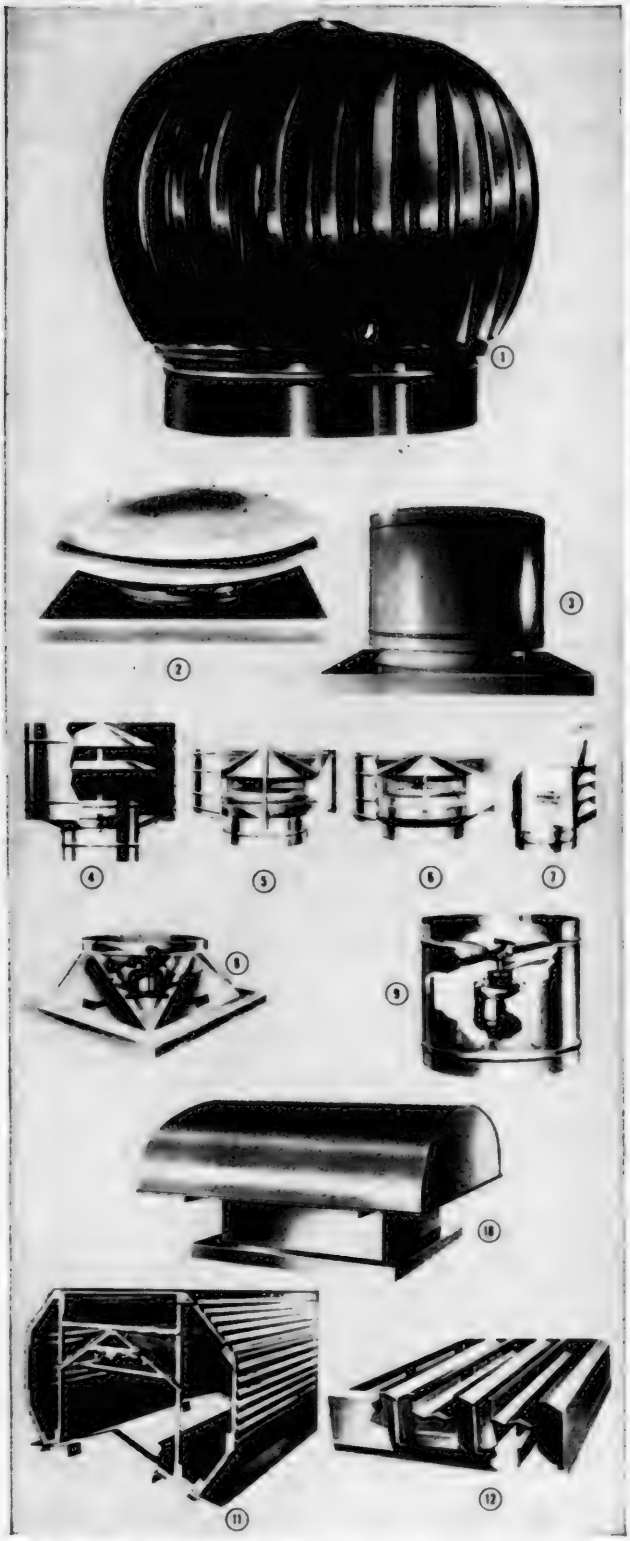

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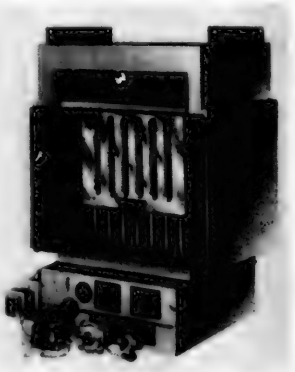
Gas-Fired Duct Furnaces

The installation of duct furnaces downstream of cooling surface in air conditioning systems is now practical with the new line of duct furnaces offered by Modine Manufacturing Co., Racine, Wis. The design is said to offer many application opportunities.



A built-in by-pass offered as standard equipment eliminates the need and expense of adding separate by-pass duct to handle the greater cfm required by systems which provide cooling. As a result, all air passes through the duct furnace, reducing internal static pressure.

For protection from the ravages of moisture-laden air and condensation, all burners are stainless steel; heat exchangers are either stainless or aluminized steel; casings are aluminized steel. The new line is specifically designed to accommodate air conditioning applications. Furnaces may be installed side by side in unlimited numbers within any one of three height groupings.

The line is offered in six sizes ranging from 75,000 to 300,000 Btu per hr input. All models are A.G.A. approved for use on natural, mixed or LP gases. All controls are designed for 24-volt service and can be converted to 115 and 230-volt operation by means of an optional transformer.

More Information? Circle ITEM 78 on Inquiry Card.

High Temperature Insulation

A thermal insulation that withstands soaking heat up to 1800 deg F indefinitely and has the added advantage of being an industrial fireproofing material has been developed by The Ruberoid Co. New York, N. Y. Known as Calsilite-Hi, the product is effective for insulation of piping and equipment in all types of plants, and for fireproofing walls, partitions and ceilings in refineries and chemical processing plants, the company states.

Insulation is a calcium silicate compound combined with asbestos fibers and other materials. Available in half-sectional, three segmental and block form, it keeps its strength when wet and returns to its original thermal efficiency when dry, and it resists most chemicals and alkalis in industrial concentrations.

Calsilite-Hi complements Ruberoid regular Calsilite designed for use on high temperature steam lines and equipment up to 1250 deg.

More Information? Circle ITEM 79 on Inquiry Card.

(Continued on page 130)

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a precision engineered tool designed for fastening wood or metal to concrete and steel

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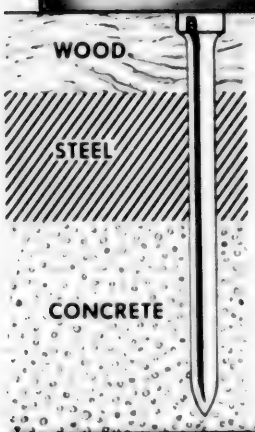

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EXCLUSIVE

#1 Insured angle fire control while using the barrel extension.

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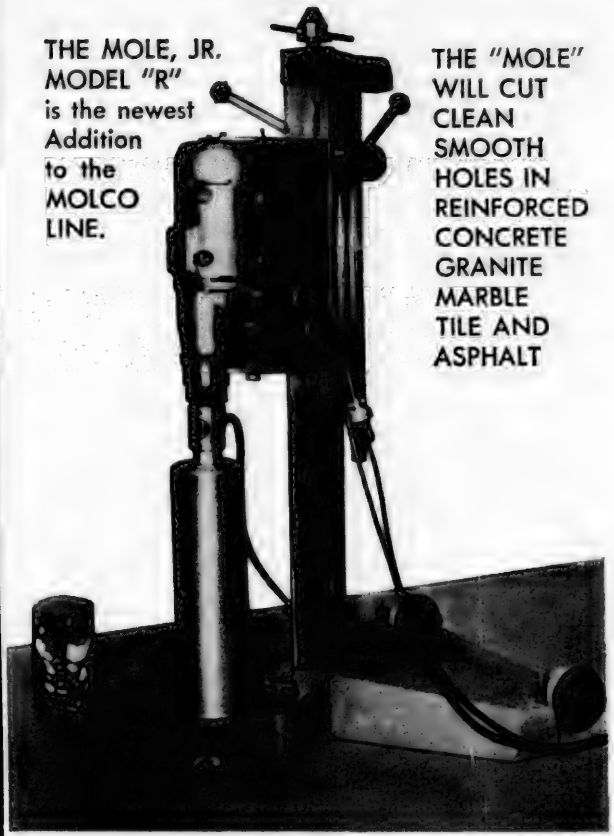
THE MOLE JUNIOR MODEL "R"

THE MOLE, JR. MODEL "R" is the newest Addition to the MOLCO LINE.



THE "MOLE" WILL CUT CLEAN SMOOTH HOLES IN REINFORCED CONCRETE GRANITE MARBLE TILE AND ASPHALT

"Lowest Cost Per Hole" with "MOLCO DIAMOND DRILLING SYSTEM" because MOLCO engineering and know how-offers you . . . . . .

- Job Proven Designed Machines
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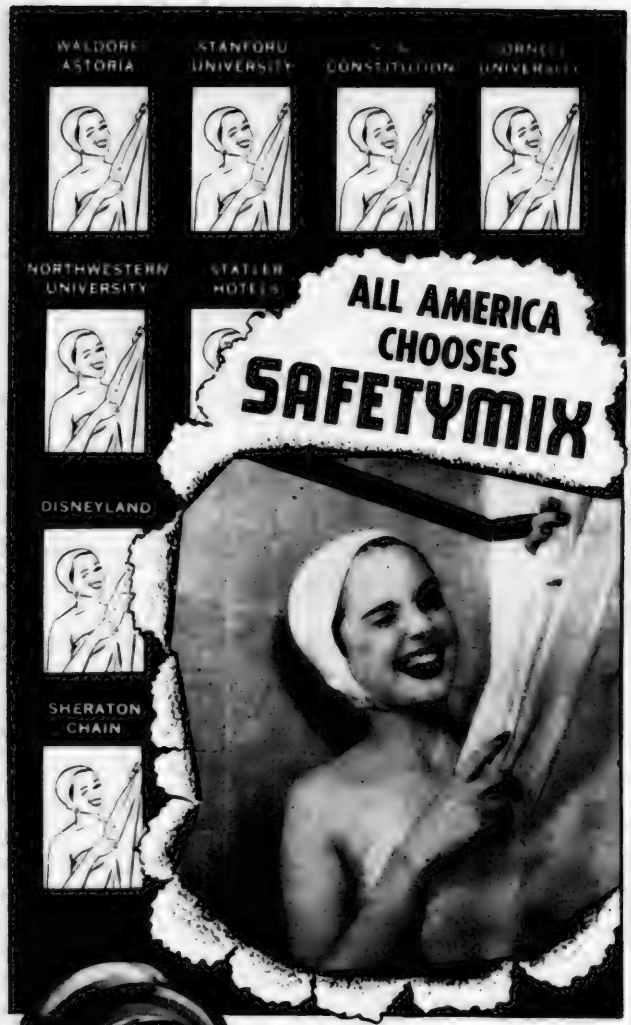

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NON-SCALD
SHOWER VALVE

- Proven superior in thousands of installations
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- No sudden scalds or chills regardless of water pressure
- Built to last a lifetime . . . only one moving part
- Self-cleaning action prevents clogging — saves water

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Redesigned Blowers Are Quieter

Redesign of its BC (backward curved) line of centrifugal blowers to meet increasing and anticipated needs for higher pressure, greater volume, higher velocities, and quieter operations was announced by Bayley Blower Co., Milwaukee, Wis. Key to redesign is a new fan wheel structure which incorporates mechanical changes based on requirements set by consulting engineers to the air conditioning and processing industries.

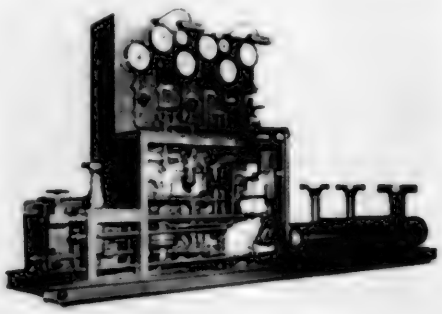
Fan wheel has a deepened inlet cone and all welded, backward curved, spun wheel shrouds. This design for both single and double width wheels also allows for finer tolerances between stationary and moving parts, the company states.

Applications range from air conditioning systems to industrial processing.

More Information? Circle ITEM 80 on Inquiry Card.

Universal Test Stand

Now available at one-third the cost of built-in-plant test stands, this universal unit manufactured to ASME requirements by Farris Engineering Corp., Palisades Park, N. J., will test all valves, including globe, gate, plug cocks, safety and relief valves, plus other hydraulic-pneumatic equipment.



This test stand completely eliminates expensive, time consuming outside valve maintenance and related shipping costs. Valve inventory can be reduced to a minimum by using the Farris test stand to reset valves to use them in the widest possible variety of applications and pressure variations. It permits quick, efficient, low cost testing of safety valves for maximum protection of plant and personnel. The test stand's built-in compressor provides a useful source of compressed air for general plant service.

Easy to operate, the stand requires no special skill or training. All controls are within reach on one panel with simple instructions printed on metal plate. It is compact (10½ by 3 ft) yet its wide range permits testing of pressure settings up to 2000 psi for air and 6000 psi for water.

More Information? Circle ITEM 81 on Inquiry Card.

Conditioner Has Clock-Timer

The 1961 line of its room air conditioners will incorporate a clock-timer, called Climatimer, according to Fedders Corp., Maspeth, N. Y. It can be pre-

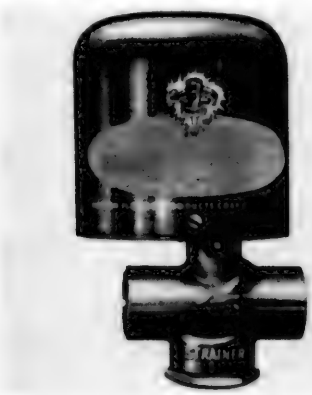
set to start the unit at any hour so that the consumer will not have to cool an empty house or come home to a hot one.

Company's line consists of a full series of models for double-hung and casement windows in capacities from 7,000 to 20,000 Btu per hr. Clock-timer is mounted with the 360-degree outlet grille, but does not rotate with it. It operates as an electric clock as long as the air conditioner is plugged into the electrical circuit.

More Information? Circle ITEM 82 on Inquiry Card.

Hydronic Heating Zone Valve

Zonar (zone) valve, offered by Modern Flo-Trol Products Corp., Babylon, L.I., N.Y., is said to be a quickly installed and practically maintenance-free control for hydronic heating systems. Its removable strainer can be serviced by the user.



Strainer protects working parts from foreign matter. A non-strip, 24-volt, 60-cycle motor has a built-in click signal that notifies the user of valve restriction. By simply loosening a nut and removing the butterfly, the cause of restriction is quickly and easily removed.

In the event of thermostat or transformer failure, valve can be operated manually for gravity flow without disturbing the motor assembly.

More Information? Circle ITEM 83 on Inquiry Card.

FOR MAXIMUM HEATING
OR EXHAUSTING EFFICIENCY
AT LOWEST COST

Patents 2,722,372 and 2,855,874 and Patents Pending plus Exclusive Foreign Patents.

...Specify

Quickdraft

POWER-DRAFT UNITS
DESIGNED FOR RESIDENTIAL,
COMMERCIAL AND INDUSTRIAL
APPLICATIONS

★ No motors, fans or bearings in exhaust line ★ Needs no stacks ★ Acid-resisting vitreous enamel finishes ★ Extremely high static pressures now available

FOR HEATING PLANTS AND INCINERATORS . . . *Quickdraft* provides constant draft for efficient and economical combustion. It eliminates pulsating or chattering, puffing, smoking and sooting. Costly, tall, unsightly stacks are unnecessary.

FOR INDUSTRY . . . *Quickdraft* now offers extremely high static pressures for EXHAUSTING corrosive gases, abrasives and paint sprays . . . for CONVEYING all types of bulk materials or wastes that can be moved by air.

FOR MOVING AIR in or out of buildings through ducts . . . *Quickdraft* is outstanding in performance and efficiency.

9010-QD

IMPORTANT NOTICE

To withstand corrosive gases, all *Quickdraft* units are available in standard acid-resisting vitreous enamel, No. 316 Stainless Steel, rigid plastics (P. V. C.) and with plastic and Fiberglass coatings.

Write today for Quickdraft Engineering Data.

Quickdraft CORPORATION P. O. BOX 87-O • CANTON 1, OHIO

BIG STEP
in Modernizing a Duct System

Seal it with Arno Ductape. Unsealed ducts can't be efficient. A test in a typical home increased air flow at room registers an average 21% — simply by sealing all accessible duct joints with Arno Ductape, which sticks instantly and holds permanently.

Customers like and gladly pay for results like this. It's a low-cost service that makes friends — and profits, too.

If you are not now using Arno Ductape why not make your own test of the income and goodwill opportunities of this service? We'll gladly send a sample roll for demonstration.

SEND FOR FREE SAMPLE

Arno®
ADHESIVE TAPES, INC.
Warehouses at New York, Detroit, Atlanta, Minneapolis, Ft. Worth and Los Angeles. Sales offices in other principal cities.

ARNO ADHESIVE TAPES, INC.
Dr. Scholl's Adhesive Tapes Division
4106 Ohio Street, Michigan City, Indiana

Please send me a free 15-ft. sample. ☐ Flame-resistant, ☐ Non flame-resistant. I am a ☐ Jobber, ☐ Contractor.

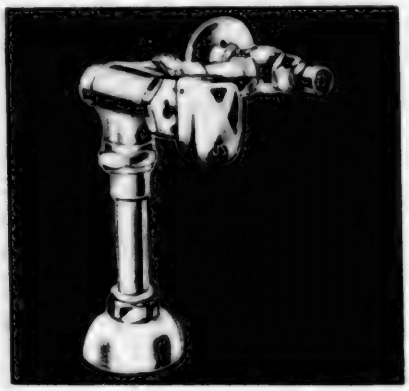
Name _____
Company _____
Street _____
City _____ State _____

MANUFACTURERS AGENTS WANTED FOR SELECTED AREAS

New Type Urinal Flush Valve

The Easy-Push urinal flush valve, a new type of self-closing metering valve for stall urinals, is introduced by Speakman Co., Wilmington, Del. It is said to offer savings in water consumption and to be maintenance-free.

To operate the valve requires only fingertip pressure



applied to a pushbutton handle. Once the handle is depressed, it returns slowly to the off position and closes automatically. Travel of the pushbutton governs the amount of water discharge. Water volume is adjustable. A special key and wrench are furnished for this purpose.

More Information? Circle ITEM 84 on Inquiry Card.

Fan Boasts "Strongest Blade"

A new industrial fan, said to have the strongest blade in the industry, has been designed by Metal Products Div., Koppers Company, Inc., Baltimore, Md. Called Aeromaster Series 8, the fan has undergone extensive tests and is now in full production.

The one-piece, heat-treated blades will be manufactured by a high production casting technique, rather than the sand cast method formerly used, permitting significant savings in production costs, the company states. They will be made of an advanced aluminum alloy to take advantage of its lightness in weight and high resistance to fatigue and corrosion. The blades, containing 7% silicon and 0.3% magnesium, have an endurance limit of 13,000 psi as compared with 8,500 psi for the sand cast blades.

Ductile cast iron hub, only 16 inches in diameter, serves to maintain maximum air flow around its periphery. It also provides better gear reducer cooling. It can be installed by itself and the blades bolted into position later.

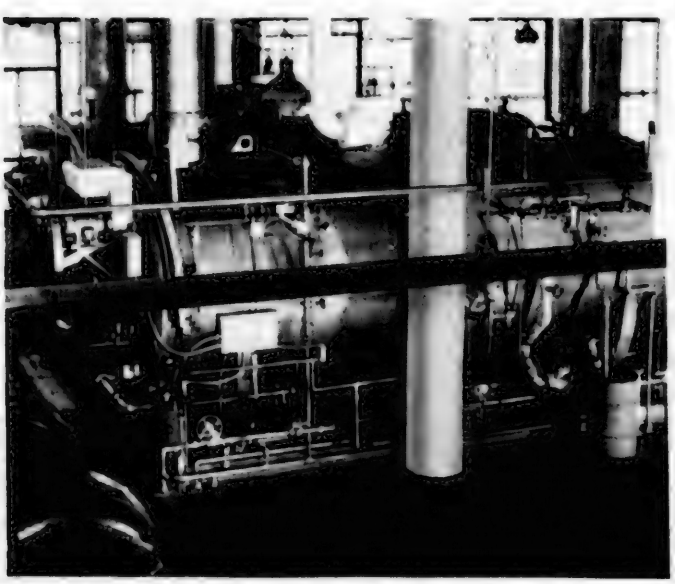
The series provides an eight-bladed model capable of operating against a static pressure up to 2.00 inches of water column. Sizes will range from 54 inches in diameter to 120 inches. The new fan will be of particular interest to manufacturers of high performance radiator-type cooling equipment, air conditioning and refrigeration units, and diesel locomotives.

More Information? Circle ITEM 85 on Inquiry Card.

can you afford to recommend a boiler designed 20 years ago?

BOILER ROOM CONVERTED TO WORK AREA

Robert A. Johnston Company, cookie, candy and chocolate products manufacturer in Milwaukee, Wisconsin, replaced four coal-fired boilers with two fully automatic, gas-fired CB boilers. Mr. James Vida, plant engineer, reports: "Compact Cleaver-Brooks design made it possible for us to install the boilers in another part of the plant — in an area of only 750 sq. ft. — releasing the old boiler room, 9000 sq. ft., for storage and work areas. It saved us the cost of an expansion project."



Today, with building costs twice what they were in 1945, your clients can't afford big boilers and the space to house them. They probably need greater boiler capacity, but they need extra space even more. The problem is to satisfy both needs.

To keep pace with climbing construction costs and the compact requirements of modern architecture, one manufacturer, Cleaver-Brooks, has proved that big boiler performance and capacity can be engineered into a small boiler package. Today's CB packaged boilers help solve many unusual installation problems. Low headroom is one example. Shortage of ground-level space is another; clean-cut, compact design cuts the space used, releases it for production or storage purposes. In some cases, "penthouse" installations have utilized space on an upper floor and *completely eliminated* the use of ground-level space.

Here are some of the features that combine for maximum space saving: four-pass design, forced-draft combustion, updraft construction and all the advantages of five square feet of heat-transfer surface per boiler horsepower. These standards of quality and compactness are only available from Cleaver-Brooks, manufacturers of the most compact, fuel-saving packaged unit on the market.

Cleaver-Brooks boilers are completely pre-engineered and tested as a package . . . expertly started by a trained field engineer. Sizes through 600 hp . . . oil, gas and combination oil-gas firing . . . larger sizes in Cleaver-Brooks Springfield water-tube boilers.

See your local Cleaver-Brooks agent or write for a set of boiler-room templates designed for consulting engineers.

Cleaver Brooks®

ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

CLEAVER-BROOKS COMPANY

Dept. L, 315 E. Keefe Ave., Milwaukee 12, Wisconsin

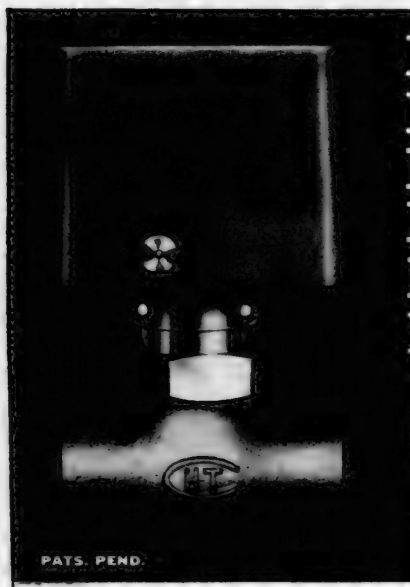
ADVISORY COMMITTEE

(Continued from page 14)

the Board of Directors and presidents of local chapters of ASHRAE. The heads of associations representing major interests in the field of heating, refrigeration, cooling, ventilation and air conditioning are also included on the committee.

Nearly 500 exhibitors are planning displays for the show, which, it is said, will make it the greatest array of heating, refrigerating, ventilating and air-conditioning equipment ever assembled under one roof. A world-wide attendance, breaking all records for registration of visitors, is anticipated.

E. K. Stevens, president of the International Exposition Co., with permanent headquarters at 480 Lexington Avenue, New York 17, N. Y., is Exposition manager.



PACKLESS
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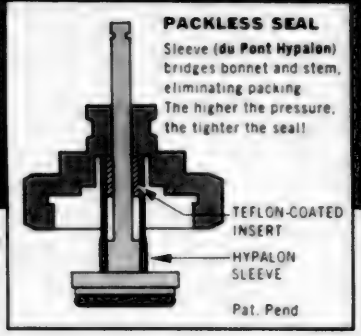

PACKLESS SEAL
Sleeve (du Pont Hypalon) bridges bonnet and stem, eliminating packing
The higher the pressure, the tighter the seal!
TEFLON-COATED INSERT
HYPALON SLEEVE
Pat. Pend

ZONVALVE®

the zone control valve constructed to last!

Engineers and heating men know—it's *construction* that tells the story!

Zonvalve's packless design (Hypalon sleeve and teflon-coated stem) means no friction—no wear—no adjustments. Zonvalve *can't* leak!

A heavy-duty motor powers Zonvalve. Pinion, spur gear and cam assembly relieves motor strain, guarantees long operating life.

Zonvalve's globe-type construction insures 100% shut-off, providing positive temperature control with no heat waste through "seepage."

Those are the unique construction features behind Zonvalve's 5-year written unconditional guarantee.

Zonvalve is easy to install, and operates with equal efficiency mounted in any position. It is made in all standard pipe and tubing sizes, straight and angle, from ⅜" to 1¼". Hand-size compactness permits installation in space as small as a baseboard enclosure. And, of course, wiring is low-voltage.

For positive temperature control on steam and hot water systems, for modernization or new construction—specify Zonvalve, install Zonvalve!

Zonvalve's Trade-Mark is your guarantee of positive zone control. Accept no substitute!

ZONVALVE

Write for Brochure D-10

HEAT-TIMER CORP. 657 BROADWAY, NEW YORK 12, N. Y. MFRS. OF HEATING CONTROLS SINCE 1937

IN CANADA: HEAT-TIMER CO. · 767 WARDEN AVE., SCARBOROUGH · TORONTO, ONT.

OHI ESTABLISHES TEST FOR TANK RUST INHIBITORS

Technical Division, Oil Heat Institute of America, Inc., New York, N. Y., has completed the preparation of procedures for a general qualification test for water-soluble heating oil storage tank rust inhibitors, OHI announced.

Tank corrosion inhibitors will be permitted to use an "OHI Approved" sticker on certification of a successful OHI test by a recognized independent testing agency such as Robert W. Hunt Co., Chicago, or Pittsburgh Testing Laboratories, Pittsburgh, or by university laboratories doing such testing, such as those of Kansas State College, Applied Mechanics Department or the University of Minnesota, Department of Mechanics and Materials.

The test itself subjects a cold-rolled, low carbon steel specimen of prescribed size to continuous contact for a period of thirty days with synthetic sea water into which a sample of the rust inhibitor under consideration has been introduced. The experiment is performed in quadruplicate and the formation of any rust, which may show up in a number of ways, is evidence of failure of the inhibitor to pass this test.

To date, inhibitors used by six major oil suppliers have been approved according to OHI Technical Committee standards.

NEW PROCEDURE RECOMMENDED FOR CONSTRUCTION SUB-BIDS

The National Joint Cooperative Committee of the Associated General Contractors and the Council of Mechanical Specialty Contracting Industries, Inc., have issued a new recommended procedure for receiving and handling sub-bids for the building construction industry, reports *Building Science News*, BRI publication. The recommendation also urges that AIA review this plan and implement its adoption by local AIA chapters.

Included are the mechanical and

(Continued on page 136)

Allied forms new Heating, Airconditioning, & Piping Division to serve specifiers, installers, & users of Flexible Pipe Connectors

Offers complete Allflex service for controlling pipeline motion in heating, cooling, & plumbing systems

Immediate, experienced, on-the-spot service in solving pipeline problems caused by vibration, thermal expansion, and misalignment is now offered by Allied Metal Hose Company's new "H.A.P." Division, the latest specialized unit created under the firm's continuing expansion program.

The new division will serve Mechanical Engineers and Contractors thru a nationwide network of factory trained pipe-motion-engineering sales specialists, according to an announcement by Fredric R. Cahn, the company's Director of Sales. Backed by ALLIED's extensive engineering and custom-fabrication facilities—these specialists are now at the disposal of heating, cooling, and plumbing engineers, contractors, distributors and jobbers who design, specify, furnish or install piping for pumps, compressors, turbines, condensers, cooling towers, radiators, or other fluid or air handling machinery in commercial and industrial building.

Typical H.A.P. Flexible Pipe Connectors include:

A) H.A.P. FLEXible PIPE-to-pump Connectors,

B) H.A.P. FLEXible COMPressor-to-pipe Connectors,

C) ALLFLEX VIBRATAMERS Installed at suction and discharge ports of pumps and compressors to absorb, attenuate and isolate vibration, preventing its full transmission to the pipeline; absorb & compensate for dimensional changes caused by temperature induced pipeline contraction & expansion; and to take up slight pipeline misalignment. H.A.P. connectors minimize unbalance and excessive wear, insuring longer pump and compressor service life, and reducing maintenance time and cost.

These connectors consist of a corrugated and braided flexible tube, with Threaded, Flanged, Tube or Pipe ends. Furnished in all standard sizes—thru 16 in. in Stainless Steel, 8 in. in Bronze & Hot-dip-galvanized Steel, and 4 in. in Monel (an ALLIED "first").

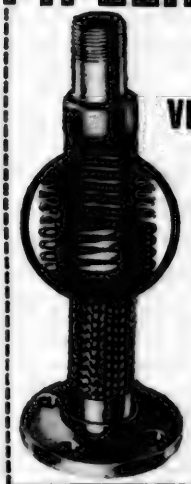
D) H.A.P. Expansion Compensators

Absorb and take up pipeline expansion at right angles to direction of movement. Designed to meet specified working conditions, these expansion compensators come in a wide variety of constructions (including unbraided for low pressures).

For complete information, experienced assistance, and the name of the Allied HAP Division Representative in your area, Write, Wire or Phone

ALLIED METAL HOSE COMPANY, Long Island City 1, N. Y., (STillwell 4-5173).

CALM Jittery PIPELINES



ALLFLEX VIBRATAMERS! Custom-Engineered FAST to solve your problems. In Stainless Steel, Bronze, Monel write, wire, phone today for "VIBRATAMER" DATALOG 601

ALLIED METAL HOSE CO.

3761 Ninth St., Long Island City 1, N. Y.
Telephone: STillwell 4-5173

FLEXIDIZE

YOUR RIGID PIPELINE CONNECTIONS

Standard ALLFLEX MNH *flexible pipe connectors*

FROM STOCK IN STAINLESS STEEL MONEL • BRONZE

solve your pipeline flexation problem!

write, wire, phone today for your Allflex Datalog 611

ALLIED METAL HOSE CO.

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Long Island City 1, N. Y.
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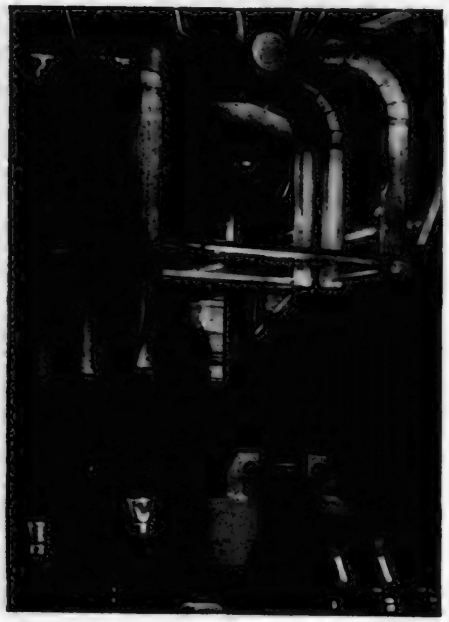
YOU SAVE MORE WITH FLEXAUST® HOSE



Thousands of successful installations prove that use of Flexaust hose and Portovent retractable duct with metal duct systems lower installation costs – but there are other important advantages

Exceptional abrasion resistance
Corrosion resistance
Noise absorption
Durability under heavy flexing
Provision for expansion and contraction
Easy relocation of hoods and machines

Made of high quality neoprene coated fabrics 1¼ to 36" i.d.

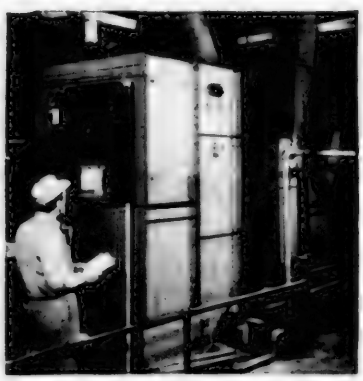
Write today for full details
Distributors in all principal cities

THE FLEXAUST CO.
DEPT. HV-10 100 PARK AVE.
NEW YORK 17, N. Y.

DRY and CLEAN AIR at the RIGHT TEMPERATURE

- **to control your product quality**
- **to protect a critical operation**
- **to protect apparatus from moisture damage**
- **to DRY your material or product**
- **to control packing or storage conditions**
- **to assure precision in testing or research**
- **to increase air conditioning capacity**

Air Condition by the NIAGARA Method Using HYGROL Liquid Absorbent



This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

Most effective because... it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

Most reliable because...the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions... no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

Most flexible because...you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Write for Bulletins 112 and 131 and complete information on your air conditioning problem.

NIAGARA BLOWER COMPANY
Dept. HV-10, 405 Lexington Ave., New York 17, N. Y.
Niagara District Engineers in Principal Cities of U. S. and Canada

(Continued from page 134)

electrical subcontractors who perform the plumbing, heating, ventilation and air conditioning and electrical work. Procedure calls for prime contractor to list the name of the mechanical specialty contractor whom he proposes to use, or to submit a statement naming all those from whom he endeavored to obtain sub-bids, and permitting the prime contractor to require from the mechanical specialty contractor the naming of all sub-subcontractors being considered to perform various phases of the work. Copies of the recommendation are available from CMSCI, c/o NECA, Ring Building, 18th and M Streets, N. W., Washington 6, D. C.

TV TUBE PLANT AIR CLEANER THAN THE ARCTIC

Air in a part of General Electric's Power Tube factory in Schenectady, N. Y., is cleaner than the air in the Arctic.

The comparison is made by the company's General Engineering Laboratory which has been conducting regular tests of the air in the "Snow White" room where minute parts of television camera pickup tubes (image orthicons) are assembled.

Detecting, counting and controlling invisible airborne particles so tiny that 50,000 of them laid end-to-end would equal only the thickness of a human hair, has become a necessary adjunct to TV camera tube manufacture.

The company's physicists say the air in the ultra-clean factory room contains only about 3,000 of these invisible particles per cubic centimeter, while the air in an air-conditioned office has 35,000 particles per cubic centimeter and the air in a heavy industrial city is loaded with 170,000 particles per cubic centimeter.

Control of air contamination in manufacturing and assembly areas is imperative. The thin-film target used in General Electric's "see-in-the-dark" tube (GL-7629), for in-

stance, is only about two millionths of an inch thick. This is considerably thinner than most of the dust particles which can be seen dancing on a sunbeam.

A visible piece of dust on the target of an image orthicon, being used in a telecast, would appear as large as a boulder on the home viewer's screen.

Tests of the air cleanliness in the tube factory are made with a "condensation nuclei detector," developed by the General Engineering Laboratory of General Electric. This device can measure particles ranging in size from 0.001 micron (0.000000039 of an inch) to 0.1 micron (0.0000039 of an inch).

The "condensation nuclei detector" works on the principle that moisture condenses on each invisible airborne particle. With continuing condensation, the particles grow into visible droplets.

A light-scattering photometer which detects the forward scattering light from particles 0.2 to 50 microns is used to measure the larger particles.

The air is kept clean in the "Snow White" room by a combination of methods and devices which includes air-filtration and air-conditioning, frequent vacuum cleaning, air locks for entry and exit, use of lint-free clothing, hats and rubber finger coats.

KNOXVILLE CONTRACTORS WEIGH ELECTRICITY VS. FOSSIL FUELS

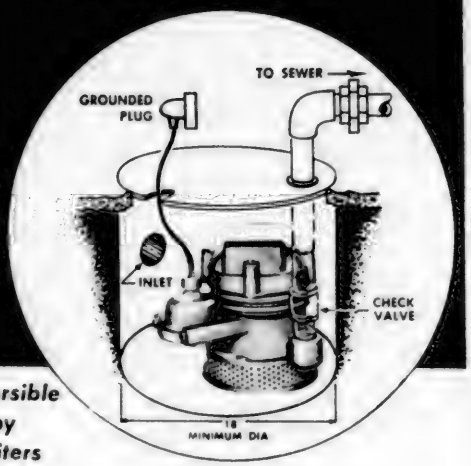
The Associated Mechanical Contractors, Inc., of Knoxville, Tenn., has issued a report of its technical advisory committee on the relative claims of electricity and the fossil fuels as heating media for schools and other public institutions.

Rating each according to "useful Btu's per penny," the committee compared the figure for coal, 18,700; fuel oil, 9,700; electric air-to-air heat pump, 8,600; interruptable natural gas plus (22%) fuel oil, 13,600; with electric resistance heat, 4,900. However, it is pointed out that these figures "cannot by themselves be the deciding factor."

the weil SUBMERSIBLE SUMP PUMP

built for submerged operation!

Priced lower than many conventional Sump Pumps



The first submersible approved by The Underwriters Laboratories, Inc.

designed for these features

TO OPERATE UNDER WATER
Hermetically sealed motor with a leak-proof rotating shaft seal assures dependable performance at all times.

FOR ECONOMICAL INSTALLATION
Is easily installed in a metal tile or concrete sump 2' to 8' deep.

FOR SMALL SUMPS
Can be installed thru a 15" opening.

FOR GAS-TITE INSTALLATIONS

FOR FLOOD-PROOF OPERATION
If current fails moisture cannot damage pump or motor.

MICRO-SWITCH CONTROL

A RUGGED SWITCH DESIGNED TO OPERATE A RUGGED PUMP

PERFORMANCE

Discharge Head (Ft.)	5	10	15	20	22	24
Capacity, GPH	3600	3350	2400	1830	1160	540

STOCKED BY YOUR JOBBER

GUARANTEED FOR ONE YEAR

Send for Bulletin SS-800 and complete prices, discounts and the name of your weil jobber nearest you.

FOR EXTRA CAPACITY
Now available with 2" discharge and ½ HP Capacitor Type motor. Also a "PLUG-IN" unit. Ask for Bulletin SE-850.

weil PUMP COMPANY

1516 N. Fremont Street, Chicago 22, Illinois

Dwyer
CONTROLS GAGES

AIR VELOCITY METER
No. 400

One Instrument Tells Both Air Velocity and Static Pressure!

- Reads directly in feet per minute and inches of water.
- Check *all* velocities from 400 to 10,000 F.P.M.
- All static pressures from 0 to 10" of water.

Tests fan and blower discharge and inlet pressures, pressure drop across filters, balances air conditioning systems, etc. Complete kit includes dual purpose manometer, 18" stainless steel pitot tube, Magneclip mounting panel and all necessary fittings, tubings, instructions and accessories.

Write today for literature and prices.

F. W. DWYER MFG. CO.

P.O. Box 373-N Michigan City, Ind.

Method of heat distribution, availability and cost of equipment, ease with which fuel can be brought into the building, availability of service parts, trained personnel, etc., must be weighed.

Recently, the committee says, bids on companion plans for Carters Valley Elementary School, Hawkins County, Tenn., one based on electric resistance unit ventilators, the other on conventional unit ventilators with hot water coils plus boiler equipment, showed the latter cheaper and its installation was ordered.

The committee notes a coal-burning installation in Holston High School, Knox County, which, owing to modern firing methods, requires only one janitor in attendance during the day, "an irreducible number for this 1000-pupil school."

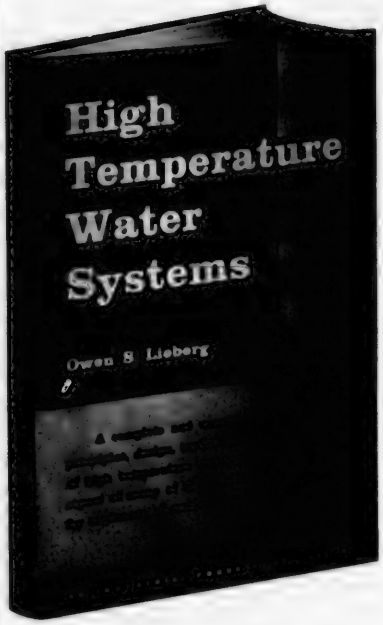
While electric resistance heat requires lower-cost installation, these costs are not enough lower, if lower, to merit an automatic preference, the committee concludes.

PUBLIC HEALTH SERVICE FORMS NEW AIR POLLUTION DIVISION

Creation of a Division of Air Pollution in the Public Health Service was announced by Surgeon General Leroy E. Burney. It will enhance and facilitate the efforts of the Public Health Service to assist states, communities and industry in their research and control activities in this expanding field of nationwide public health concern, Dr. Burney said. According to the Service, the nationwide threat of air pollution is becoming greater.

Chief of the new Division will be Vernon G. MacKenzie, engineer and long-time career officer in the Service, who is at present Assistant Chief, Research and Development, Division of Engineering Services. Mr. MacKenzie has worked in the field of air pollution for more than ten years.

Staff will include physicians, sanitary engineers, physicists, chemists and other scientists and professional specialists who have previously been working in separate medical and engineering units.



PRINCIPLES, DESIGN AND OPERATION OF HIGH TEMPERATURE WATER SYSTEMS

This book contains original design data used successfully in actual systems. Tables, graphs, photographs and specifications serve as a working guide; let you benefit from the author's extensive knowledge and experience.

CONTENTS

- Advantages of HTW
- Thermal Properties of Water
- Some Design Considerations
- Pressurizing the System
- Boilers and Expansion Tanks
- Controlling the System
- System Circulation Pumps
- Valves
- Piping
- Process Heating
- Space Heating with HTW
- Applications
- Designing a Typical System
- Appendix

224 Pages, 109 Illustrations. $6.50

To order use the postcard. See last page, this issue.

BRIEFLY STATED

NEWS ITEMS

The world's first big cooling machine for air conditioning will be a star attraction in the Smithsonian Institution in Washington, D. C. The first centrifugal was developed by the late Dr. Willis Carrier in 1922 and was installed at the Onondaga Pottery china factory in Syracuse, N. Y. After almost 38 years of service, it will form the center of a refrigeration exhibition scheduled to open in a new wing of the Smithsonian next year.

WITH THE ENGINEERS

ROBERT M. CRICHTON, civil engineer, announced the opening of his office as a consulting engineer at 13 Third Street, Hood River, Ore. Having recently resigned as Hood River's City Engineer, he offers his services in the fields of water and sewer systems, drainage and flood control, roads and streets, site planning, industrial buildings, and foundations. . .

FRED S. DUBIN ASSOCIATES, Consulting Engineers, announced the appointment of Gene A. Gessner as Associate in charge of the Mechanical Engineering Department in the New York Office. Mr. Gessner, a registered professional engineer, will handle all matters in the realm of heating, ventilating, air conditioning and related mechanical engineering trades for the firm's expanding New York Office. . .

Technical engineering services, manufacturing and assembly facilities, field service and engineering coordination of automated variable speed equipment systems, are now being offered by FLOW DIVISION, BASIC CONTROLS, INC., Glen Ellyn, Ill., and Cleveland, Ohio. One major application of these unit systems is in "house" water supply systems. Other uses are in municipal booster stations, heating water circuits, cooling tower water supply, chilled water circuits, and hydronic systems. Spark plug behind

SELL MORE "TOUGH CLIENTS" WITH REZNOR...

more types and sizes of direct-fired heaters to choose from!

Now you can satisfy "tough clients" with just the right model heater for every job. The Reznor line features more types and sizes than any other! Choose from:

- Money-saving, space-saving unit heaters with three control options, propeller or blower fans, 25,000 to 30,000 Btuh.
- Low cost, versatile duct furnaces in capacities of 50,000 to 300,000 Btuh and up, for central heating, year-round air conditioning, or heating of make-up or process air.
- Matching, quiet-operating blower packages, if a separate air handler is needed.
- The new Reznor Venter, an automatic vent exhauster that lets you install Reznor unit heaters almost anywhere.
- Effective, five-way heaters for high ceiling applications, 300,000 to 600,000 Btuh.
- Heavy duty, forced air heaters, 400,000 to 2,000,000 Btuh, that you can floor-mount or suspend, and use with air discharge nozzles or ductwork.

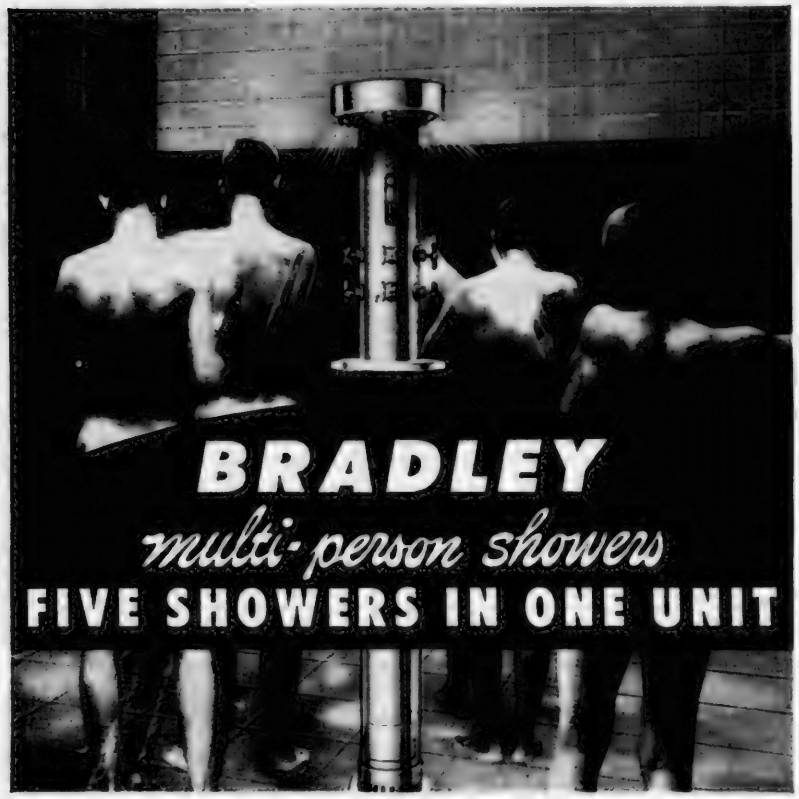
Ask your Reznor representative for a copy of Catalog SA-5900, with complete data on all Reznor heaters. Or write Dept. 64-R. Reznor Manufacturing Co., Mercer, Pa.

REZNOR HEATERS

"WORLD'S LARGEST SELLING DIRECT-FIRED HEATERS"

this newly formed concern is Roy Henderson, sales manager, formerly specifications specialist with Peerless Pumps, Hydrodynamics Division, Food Machinery & Chemical Corp., Chicago. . .

CARRIER CORPORATION, Syracuse, N. Y., has issued System Design as Volume III of its set of reference material on air conditioning and refrigeration. The first three parts of this volume covers load estimating, air distribution and piping design. Other sections are being planned so that ultimately this volume will consist of 12 parts covering some 750 pages. The first three sections of this volume are now being distributed to Carrier field offices for release to consulting engineers. All sections will be available as separate books at nominal cost. . .



Shower facilities can now be installed quickly, at low cost and in small space.

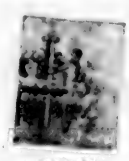
Thousands of students in schools and colleges enjoy facilities provided by Bradley Multi-Person Shower Columns as shown above. One column has 5 shower heads—but requires *one* set of piping connections. Yet each bather has individual control of water volume and temperature. Soap dispensers are also available. For Girl groups, the same Shower Column is supplied with 5 stall-separating partitions and with curtains for greater privacy if desired.

To insure top sanitary wash and shower facilities—install Bradleys. All models are illustrated in Bulletin H-1322—copy mailed on request.

BRADLEY WASHFOUNTAIN CO., 2352 West Michigan Street, Milwaukee 1, Wisconsin.

Same Column with stall-separating partitions and curtains.

Bradley



Write for Bulletin H-1322

Jack F. Fritchman recently joined the Engineering Department of the EVANSVILLE DIVISION OF BENDIX-WESTINGHOUSE as engineering manager of compressor development. Prior to joining the Bendix-Westinghouse engineering staff, Mr. Fritchman was with the York Division of the Borg-Warner Corporation for some 12 years. At the time of his leaving, he was product design engineer in the hermetic compressor section. . .

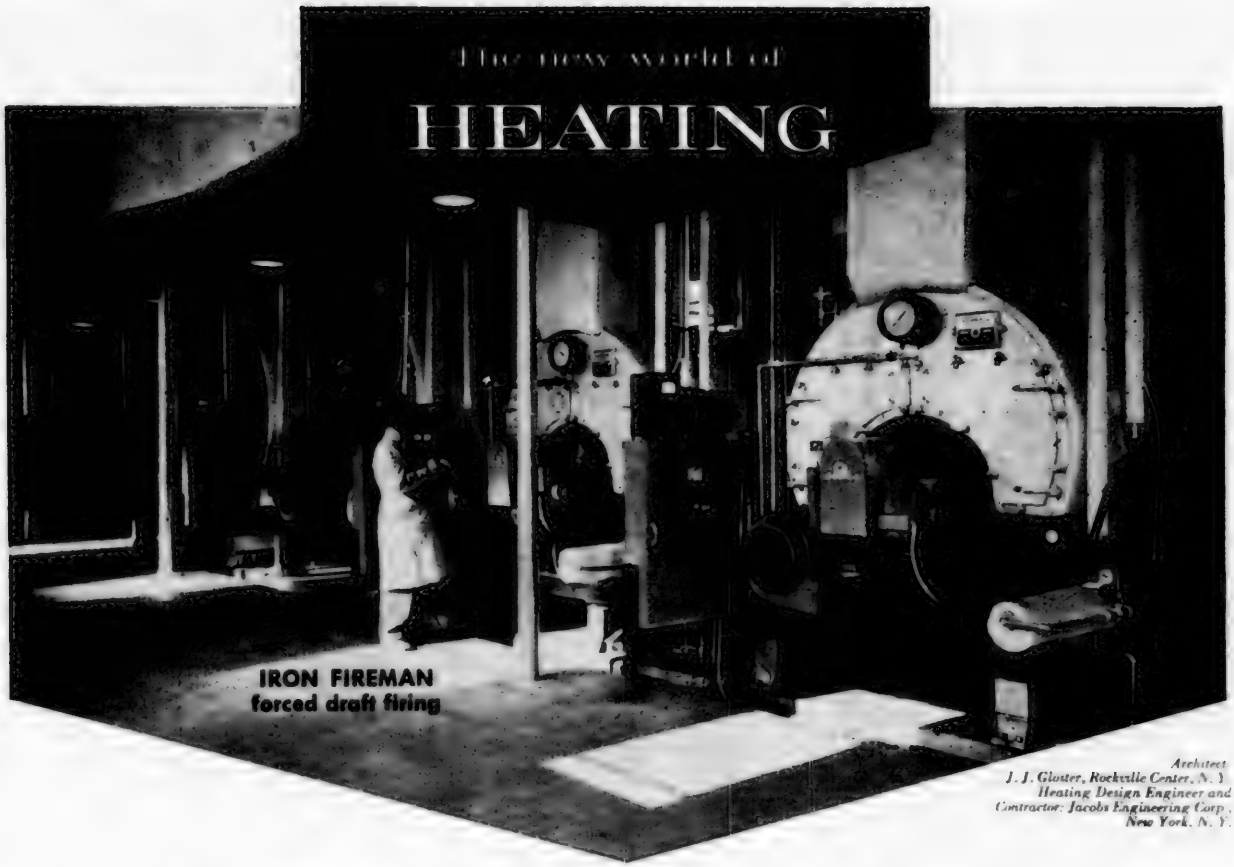
ALLIS-CHALMERS CENTRIFUGAL PUMP DEPARTMENT, West Allis Works, has announced the following appointments: Joseph J. Jacobs, chief engineer; C. L. Babb, senior staff engineer, and W. W. Weltmer, senior development engineer. Mr. Jacobs had been assistant chief engineer. He started as a design engineer in the centrifugal pump department in 1940 and was engineer-in-charge of design for three years prior to being named assistant chief engineer in May, 1959.

ASSOCIATION NEWS

After 22 years as faculty member of North Carolina State College, where he taught courses in plumbing, heating and air conditioning, Professor T. C. Brown becomes a field engineer for CAST IRON SOIL PIPE INSTITUTE. A registered engineer, he has carried on professional engineering projects off-campus during summer vacations and at other times. These projects include designing plumbing, heating, air conditioning, and refrigeration installations, as well as miscellaneous engineering jobs such as designing swimming pools and septic tanks. For several years past, he has taken an active part in the "Plumbing Inspectors' Short Course," given at North Carolina State College . .

Lester B. Inglis, Jr., formerly with The Columbia Gas System's United Fuel Gas Co., Charleston, W. Va., has been named assistant secretary of AMERICAN GAS ASSOCIATION'S 3,700-member Operating Section. He succeeds Fredric

(Continued on page 142)



Architect:
J. J. Gloster, Rockville Center, N. Y.
Heating Design Engineer and Contractor: Jacobs Engineering Corp., New York, N. Y.

"Today's package units remove uncertainty"

says Mr. Fred Reidel, Chief Engineer, Mid-Island Hospital, Bethpage, L. I.

"The old-fashioned way of installing boilers," says Mr. Reidel, "required that we get separate estimates for burners, steel front plate, brick combustion chamber, oil heating equipment and wiring. Everything was assembled at the site. Now the finished unit is simply lowered into place and bolted down."

A single contract not only keeps your installation costs under control, but greatly reduces these costs as well. It also narrows responsibility for the proper installation and functioning of the equipment.

Easy to size and specify. After determining the required load and deciding on the fuel (gas, oil or dual-fuel combination), it is only necessary to refer to a chart to find the correct size of unit, or units, for your job.

Multiple units have many advantages. You can have a tailor-made plant with low initial cost. A stand-by unit protects you against emergencies or peak loads. You can split your plant between high and low pressure boilers to meet special needs, or between steam and hot water units. Capacities range from 10 to 650 boiler horsepower.

For full information, please mail the coupon below

IRON FIREMAN

HEATING AND AIR CONDITIONING
AIRCRAFT COMPONENTS AND EQUIPMENT
MISSILE AND AIRCRAFT GYROSCOPES
ELECTRONIC EQUIPMENT
CONTROL INSTRUMENTS

Iron Fireman Mfg. Co., 3090 West 106th St., Cleveland 11, Ohio. (In Canada, 80 Ward St., Toronto)
Please send complete technical descriptions and specifications for oil, gas or oil-gas combination firing.

Name _____

Company _____

Address _____

City _____ State or Prov. _____

PALMER

Mercury Actuated Dial Thermometers now in three types to suit any requirements

PALMER
PATENTED
FULL 4½" DIAL FACE
Stem can be placed at any angle and case can be rotated to any readable position
1 RIGID STEM DIAL THERMOMETER tapered bulb interchangeable with standard industrial thermometer separable socket. (As illustrated above)
2 WALL MOUNTED DIAL THERMOMETER with flexible connecting armor. Case adjustable to easy reading position
3 FLUSH MOUNTED DIAL THERMOMETER for panel mounting with flexible connecting armor
ALL THREE TYPES HAVE A FULL 4½" DIAL FACE

■ **for accuracy:** Mercury actuated . . . Compensated by Invar. Guaranteed Accurate 1 scale division. ■ **for angularity:** Can be adjusted to most readable position at any angle desired. ■ **for readability:** Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position. ■ **for interchangeability:** Also specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

PALMER

PALMER THERMOMETERS, INC.
Norwood Ave., Cincinnati 12, Ohio
MFRS. OF INDUSTRIAL LABORATORY, RECORDING AND DIAL THERMOMETERS

Briefly Stated

(Continued from page 140)

Moshier, who has entered private business. Mr. Inglis has served for the past four years as an engineer in United Fuel's gas measurement department. He entered Columbia's service as a junior engineer in 1955. A 1953 civil engineering graduate of Lehigh University, he is a registered professional engineer in New York and West Virginia. . .

Appointment of Irving W. Clark as executive vice-president and chief executive officer of AIR MOVING AND CONDITIONING ASSOCIATION has been announced by Earl Trickler, association president. Mr. Clark served most recently as manager of American Air Filter Company's Heating, Ventilating and Air Conditioning Division. During his term as president of the Industrial Unit Heater Association, a predecessor organization, Mr. Clark was instrumental in helping to bring the present association into being. National AMCA headquarters are maintained at 2159 Guardian Building, Detroit, Mich.

* * *

It was recently Norman C. Ascher Day at SLOAN VALVE COMPANY, Chicago, Ill. Mr. Ascher, the company's Miami representative, was celebrating forty years of service. He and his wife made the trip to Chicago as guests of the company and were feted at a luncheon and dinner at one of the city's finest hotels.

* * *

NEW REPRESENTATIVES

Albert Genga, Detroit, Mich., has been named sales representative for the state of Michigan for HALSTEAD & MITCHELL CO., Pittsburgh, Pa., manufacturer of components for air conditioning-refrigeration units. Mr. Genga operates the Genga Company, handling heating and air conditioning equipment in Detroit. He was associated with the Herman Nelson

HIGHER and WIDER

New BAKER Model K Scaffold uses standard BAKER Scaffold components

1. Big 28 sq. ft. working platform area.

2. Platforms adjust in 3-inch increments—same as the standard Baker Scaffold.

3. Uses same side trusses, same metal-bound plywood platforms—(uses two), same casters, the same positive spring-loaded safety locks and many optional accessories of the standard Baker Scaffold.

4. Stairway, base extensions and casters optional.

THE BAKER SCAFFOLD
Standby for maintenance and general utility work

The Baker Scaffold is universally used in contracting and general maintenance work. Easy to transport, it assembles in 90 seconds; moves on large, easy-rolling casters.

The platform adjusts every three inches to any desired height and locks with positive spring-loaded safety latches. Will pass through doors, around sharp corners, over obstacles.

Write today for more complete information on these two utility scaffolds.

Listed Under Re-examination Service Underwriters' Laboratories, Inc.

BAKER SCAFFOLDS

DESIGNED FOR PORTABILITY • BUILT FOR DURABILITY

BAKER-ROOS, INC.
P. O. Box 892, Dept. #606, Indianapolis 6, Ind.
DISTRIBUTORS IN PRINCIPAL CITIES

Division of AAF from 1948 to 1957 and with the Sturtevant Division of Westinghouse from 1957-59. . .

Appointment of H. C. Buzza Co., 16 W. Union St., Schuylkill Haven, Pa., and of Landes, Zachary & Peterson Co., 601 South Jason St., Denver, Colo., as representatives for LEHIGH FAN AND BLOWER DIV., FULLER CO., Catasauqua, Pa., to handle both sales engineering and customer service, has been announced. The company's complete line of industrial and induced draft fans will be handled by both. . .

Two midwest sales representatives for ULOK cube air filters were named by UNION CARBIDE DEVELOPMENT COMPANY, Division of Union Carbide Corp., New York, N.Y. Selling a five-state area are: H. C. Sharp Co., St. Louis, Mo.; and Master Products Co., Chicago, Ill. . .

WARREN WEBSTER & COMPANY, INC., Camden, N. J., announced the appointment of Charles P. Austin as sales representative in the Detroit, Mich., territory. Mr. Austin is well known to leading architects, engineers and contractors in the territory and operates from his own company offices in Lathrup Village, Detroit suburb.

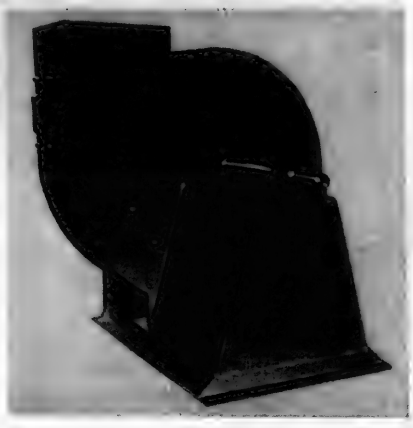
RECENT APPOINTMENTS

Joseph V. Weigle has been appointed to the newly created position of field sales manager for the Applied Machinery and Systems Department of CHRYSLER CORPORATION'S AIRTEMP DIVISION, Dayton, Ohio. His appointment was in concurrence with Airtemp's sales expansion in the heavy equipment line. The AM&S Department is responsible for the distribution, sales and service of central station equipment for large buildings. . .

Key assignments in the electronics instrumentation operations of DETROIT CONTROLS, a division of AMERICAN-STANDARD, have been announced. The moves follow the final transfer of electronic instrumentation activities from Norwood, Mass., to Detroit. Howard

This WHEEL

MAKES LEHIGH I. E. INDUSTRIAL FANS IDEAL FOR TOUGH INDUSTRIAL EXHAUST APPLICATIONS



Handles dust-laden air and gases, paper shavings and the like without clogging

Lehigh Industrial I.E. Fans . . . featuring heavy duty, unique channel construction, all-welded mild steel wheels of the long shaving design . . . solve difficult exhaust problems because of their non-clogging characteristics. They incorporate a universal housing, which permits rotation and discharge to be modified to facilitate variable field conditions.

A complete range of sizes is available in both 70° to 250°F and 251° to 600°F construction. All standard drive arrangements are available and will be furnished according to your specifications.

Rugged, air-tight construction: the fan housing is welded on the inside with a continuous fillet weld. This provides gas-and air-tight housing with joints of maximum strength.

Standard, self-aligning ball-bearing pillow blocks . . . grease lubricated . . . are featured on all Lehigh Industrial I.E. Fans.

Optional accessories include an inspection door, inlet and outlet flange, heavy duty housing construction, and drain plug.

Get detailed information on how Lehigh I.E. Industrial Fans can solve your industrial exhaust problems with dependable non-clogging performance. Your Lehigh Representative will be happy to supply you with full details. Or, if you choose, write directly to us for Bulletin L-5:

2172
LF-2

LEHIGH FAN & BLOWER DIVISION
FULLER COMPANY, CATASAUQUA, PA.
Subsidiary of General American Transportation Corporation

LEHIGH

THE ONLY DUCT THAT PERMITS THIS...

Save the cost of clamps when connecting flexible duct to metal fittings.

Wiremold's exclusive flat metal spiral construction accepts No. 7 ½" drill screws. Just 2 or 3 of these keep duct securely in place.

Groove between fabric and metal spiral holds the screw in position as you drill. One-handed fastening!

Only Wiremold Air Duct has this additional cost-cutting feature.

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FOR AIR CONDITIONING / EXHAUSTING
MATERIALS HANDLING / MANY OTHER USES

WIREMOLD®
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Briefly Stated

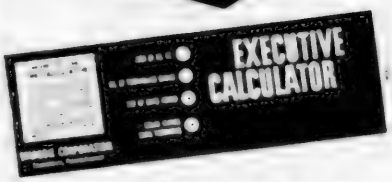
H. Elliott, former product planning manager at Norwood, has been named manager of instrumentation marketing. Robert J. Jones, sales engineer with Brush Instruments Division of the Clevite Corp., Cleveland, has been appointed instrumentation sales manager. J. M. Maitland has become technical coordinator and in this position will be responsible for customers' technical instrumentation requirements as related to the division's activities. Maitland most recently was Detroit district manager for The Bristol Co., Waterbury, Conn. All Detroit Controls activities formerly conducted at Norwood, including dynamic pressure measurement, digital telemetering for pipeline applications, and instrumentation for nuclear power plants and missiles, now are in Detroit. . .

Henry H. Kirkpatrick, former sales promotion manager for engineered machinery at the YORK DIVISION OF BORG-WARNER CORPORATION, was recently named manager, advertising and sales promotion services. Mr. Kirkpatrick's new assignment places him in charge of the firm's advertising and sales promotion warehouse, telephone directory advertising, trade shows, conventions and exhibits as well as other related activities. . .

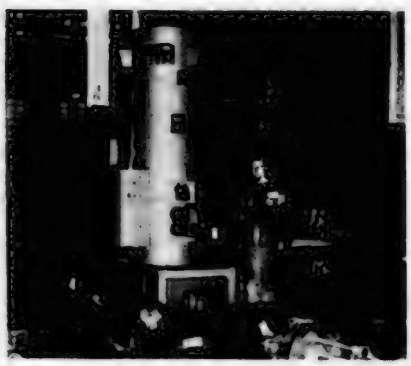
WALWORTH COMPANY, New York, N. Y., announced the appointment of Gustav A. Hoffman as vice president, sales. Mr. Hoffman will be returning to the company he served for 27 years. He left in the Spring of 1959, while holding the position of assistant vice-president in charge of Metropolitan Division Sales. . .

Carroll M. Baumgardner has retired as director of National-U.S. Sales, a division of CRANE CO., Johnstown, Pa., after serving 44 years in the heating and air conditioning industry. Beginning his career in 1916 with U. S. Radiator Corp., in Detroit, Mich., he was associated with that company until 1946, serving in sales and administrative capacities including those of executive vice president, president of Pacific Boiler and Capital Finance divisions. He joined Na-

EXECUTIVES!
Write Today For FREE Heating Savings Calculator



A request on your company letterhead will bring you our time saving calculator. Tells number and size of heaters needed for different areas. Shows dollar savings — typical heat loss calculations.



Thermobloc direct-fired warm air heaters are made in a complete range of sizes for every industrial need, from 200,000 Btu/hr up to 1,250,000 Btu/hr. They are self contained and completely automatic, using gas or oil for fuel. Manufactured and sold in 36 countries, they carry UL approval. They are low in first cost, economical to operate and give years of heating satisfaction.

Write for catalog today

WANSON CORPORATION
Lewistown, Pennsylvania

tional Radiator Company of Johnstown in 1948 as vice-president for sales, and since 1955 has served as senior vice president for sales, director and member of the executive committee of the board. He is past chairman and director of the Institute of Boiler and Radiator Manufacturers, former director of Steel Boiler Institute, Plumbing and Heating Industries Bureau of Chicago, and vice-president and director of Better Heating-Cooling Council.

OBITUARIES

Harry L. (Hap) Stevens, general chairman of the Technical Department of the NATIONAL ASSOCIATION OF PLUMBING CONTRACTORS and one of its most active members, died suddenly at his home in Hutchinson, Kan., early Sunday morning, August 14. Mr. Stevens, 62, was president of Stevens, Inc., a plumbing, heating, mechanical and refrigerating firm in Hutchinson. He had served three terms as national director of NAPC. A longtime Technical Department volunteer, he had been chairman of the Plumbing Standards Division successor to the Code Committee of NAPC. In this capacity, he was also a member of the U. S. Public Health Service Advisory Committees for Standardization and Design, and for Rural Sanitation. A past president of the Kansas Plumbing and Heating Contractors Association, he was a member of ASSE, ASHRAE, and many other technical groups. He had held all offices in his local and state professional associations. . .

William ("Bill") Ufer, of THE MERCOID CORPORATION, died August 21st of a heart attack at Columbus Hospital, Chicago. Mr. Ufer's broad experience in the heating control field and other industries extended back over a period of many years. He was associated with Mercoid for more than thirty five years. Fourteen years were spent in plant and office procedure and twenty years as sales engineer. He was a member of the Old Timers Club of The Oil Burner Industry.

SAVE SPACE and REDUCE COSTS with AURORA® VERTICAL END-SUCTION PUMPS

Capacities to 1800 GPM
Heads to 320 Feet

This close-couple, vertical mounting design provides the extreme compactness that is so important for the many applications where space allocation is critical. Flanged suction mounting cuts piping costs by direct mounting to tank. Separate foundation arrangement is eliminated along with any alignment problems. Optional discharge arrangement permits the most simplified installation.

The many desirable features of the Horizontal End Suction Pumps are retained . . . motor and rotary assembly easily removable without disturbing the suction or discharge piping . . . low NPSH . . . smooth quiet operation. Available in vertical base mounting design as well as close coupled or flexible coupled horizontal models.

WRITE TODAY FOR BULLETIN

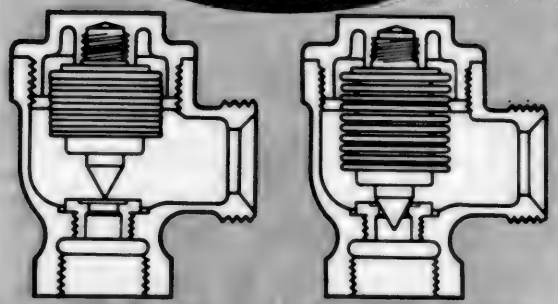
AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
690 LOUCKS • AURORA, ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

SIMPLE, TROUBLE-FREE VACUUM THERMOSTAT DESIGN ASSURES EFFICIENT, ECONOMICAL STEAM TRAP OPERATION

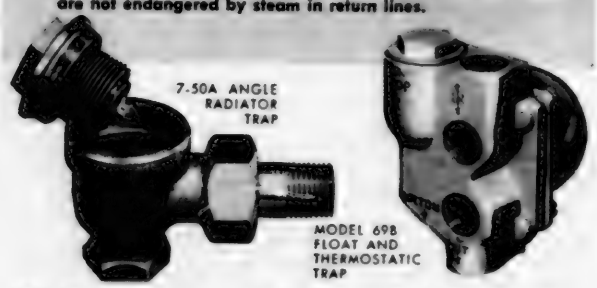
Sterlco
STEAM TRAPS



Thermostat in open position

Thermostat in expanded position

1. Sterlco Traps operate efficiently regardless of pressure variations. *Vacuum thermostat* compensates for pressure changes.
2. While vacuum in thermostat remains intact, traps require no attention other than normal maintenance.
3. If, through damage or normal wear, the vacuum is lost, the thermostat expands, closing off trap and radiator. Locating source of trouble is made quick and easy. Trap maintenance is greatly simplified.
4. Closed traps mean no wasted steam . . . vacuum on vacuum systems remains normal . . . condensation and vacuum pumps are not endangered by steam in return lines.



The Sterlco line covers the whole range of low, medium and high pressure radiator traps. Every unit thoroughly tested . . . components inspected and tested during manufacture; completed traps given operating tests before shipment. Thermostats and seats replaceable without shimming or adjustment.

Sterlco F & T traps perform dual function: float trap releases condensate water . . . thermostatic trap vents air. No. 69B has two inlets, two outlets making four installation positions possible . . . saves time, space and piping.

For complete information on Sterlco Steam Traps, write for Bulletin 102.

Leaders in temperature controls since 1916

Sterling inc.

5202 W. Clinton Ave., Milwaukee 23, Wisconsin

WHAT READERS SAY

Fog Area on Psych Chart

EDITOR, AIR CONDITIONING, HEATING AND VENTILATING MAGAZINE

In your July 1960 issue you published a letter by a Pennsylvania consulting engineer with reference to the article, "Applying Weather Data to Greenhouse Cooling" by Professor Hedlin in your April issue. I believe the question brought up by the letter is due to a misunderstanding of the psychrometric chart in the fog region.

The basic difficulty comes from extending dry bulb lines vertically above the saturation line. Actually, dry bulb lines are usually shown stopping at the saturation curve. The wet bulb or enthalpy lines will often continue out into the fog region. In this fog region the dry bulb lines are the same as the wet bulb lines. If the chart is read on this basis, the fog region is reasonably adequately covered.

Specifically, I agree with Fig. 5 in Professor Hedlin's article in that the point *D* is properly located. The reading of the dry bulb is obtained by following parallel to the wet bulb lines until reaching the saturation curve and then reading the dry bulb at that point. *D* is really indicating 79 F dry bulb and 79 F wet bulb, an enthalpy of 42.6 and a total moisture content of 152 grains per lb of dry air. However, part of this moisture is in the form of suspended droplets or liquid and something less than 152 grains per lb is in the form of vapor. The amount in the form of vapor would be obtained by projecting horizontally from point *B*.

M. A. Ramsey
Consulting Engineer
Air Conditioning Division

Worthington Corp.,
East Orange, N. J.

Mechanical Seals

EDITOR,
AIR CONDITIONING, HEATING AND VENTILATING

We read Dr. Sussman's article on Mechanical Shaft Seals appearing in your July, 1960 issue with a great deal of interest as it is a timely subject. We certainly appreciate the difficulty of obtaining and reporting of field experience with all the necessary data to reach sound conclusions, as we have had to develop an engineering and maintenance program together with investigation of mechanical seal difficulties to prevent them being unjustly condemned.

I gathered, maybe unjustly, from the cases cited that a great deal of the difficulties are due to untrained personnel handling a mechanical seal installation and mechanical conditions not being conducive to a mechanical seal. Dr. Sussman's laboratory tests showing rapid wear with misalignment of .0625 in. or less should be compared to our conception of .003-.005 in.

(Concluded on page 148)

CLASSIFIED ADVERTISING

Sold at $12 per column inch.

WANTED

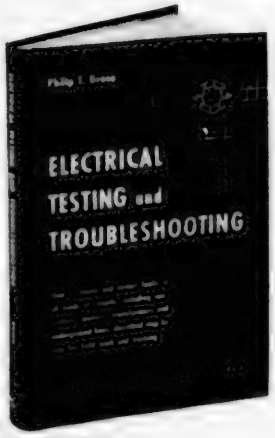
Mechanical Engineer (Air Conditioning) $7800 per annum New York City Civil Service. Requirement Resident NYC 3 years. Write or apply in person Dept. of Personnel, 96 Duane Street, NYC October 5 to 25, 1960.

TECHNIQUES OF DUCT WORK ESTIMATING
LEARN HOW THE PRO'S FIGURE THE BIG JOBS
By poundage — Square footage — Linear footage — Fittings.
This information is ordinarily very closely guarded and is invaluable to the progressive shop or individual.
Send check or money order for $3.50 payable to:
W.A.C. Co. Medway, Mass.

MANUFACTURERS AGENTS

An established manufacturer with 25 years experience producing ventilating equipment is looking for manufacturer's agents in many sections of the country to sell their new line of industrial fans. The products include axial flow and tubeaxial fans, both direct and belt driven, and power roof ventilators.
Please reply Box 914, Air Conditioning, Heating & Ventilating, 93 Worth St., New York 13, N. Y.

PRINTED FORMS available for immediate shipment. Heating & oil burner materials forms, burner service record cards, service order forms, inspection information, form, survey sheet and others. Also can supply BURNER SERVICE form in 8 part EZE SNAP with 3 carbons in each set. 1200 sets. Imprinted with your name, address and telephone, only $20.40. Send for samples—no obligation. Write Dept. AC, Degree Day Systems, 39-50 58th St., Woodside 77, N. Y.



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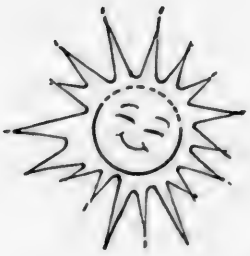
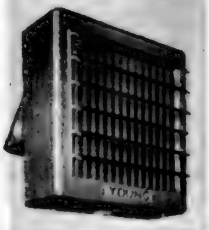
200 Pages, 100 Illustrations
$5.00

THE INDUSTRIAL PRESS
93 Worth St., New York 13, N. Y.

There's a *Young* Unit Heater for *Every* Requirement

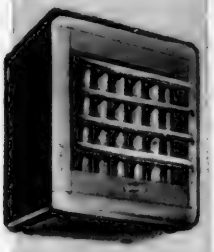


VERTIFLOW® UNIT HEATERS by Young are ideal for heating areas with high ceilings and large clear spans. Exclusive cooling stack design prolongs motor life. Wide variety of discharge outlets available. Write for Catalog No. 2659A.

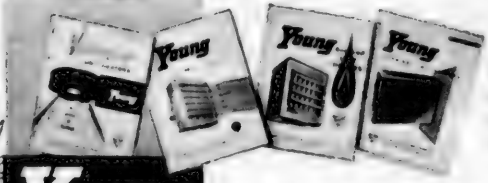


TYPE H (horizontal) UNIT HEATERS by Young provide quick dependable heat for factories, garages and service areas where heating requirements are subject to considerable variation. Write for Catalog No. 2557A.

CABINET UNIT HEATERS by Young offer maximum heat output in a wide range of capacities and attractive models. Write for catalog No. 6556-A.



GAS-FIRED UNIT HEATERS by Young are the answer for fast spot heating in areas where steam or hot water lines are not available. Output from 24,000 Btuh to 184,000 Btuh in wide range of sizes. Write for catalog No. 2760.



Capacities and piping diagrams are complete in each catalog. Write for one or all.

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POSITIVE SEALING INDICATORS
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A built-in gasket that's always in place for positive sealing and foolproof assembly.

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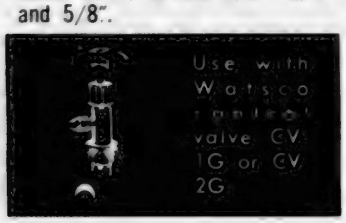
Complete with silver solder preform, the Access Saddle Valve is available in the following O.D. tube sizes: 1/4", 5/16", 3/8", 1/2", and 5/8".



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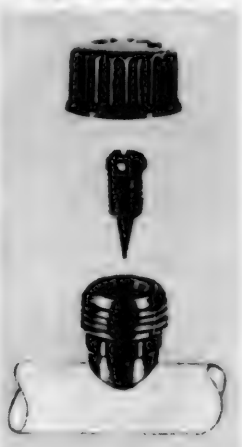

For additional information ask your wholesaler or write to Dept. V-10.

WATSCO INC.
1020 E 15th STREET HIALEAH, FLORIDA

(Concluded from page 146)

for good performance of a mechanical seal. It is extremely difficult to get the average millwright to understand how precise and how delicate a mechanical seal is until it is installed. Such innocent things as wiping the seal face on the seat of his pants causes scratches and leaks. We had just such erratic performance as described in this article until an intensive training and follow-up program was installed. This is not easy to accomplish when more or less standard equipment is to be operated by a great variety of maintenance and installation people.

It really boils down to the author's conclusion, that they are successful when better education of the users is accomplished. Until then, maybe those that refuse to understand them, or expend the energy to come to a real understanding and solution of difficulties, will have to use the stuffing box whether it is the right choice or not.

C. L. Pope

Eastman Kodak Co.
Rochester, N. Y.

BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

RADIATION HEALTH DATA—A new publication, Radiological Health Data, is being prepared as a monthly report by the U. S. Public Health Service. Starting with July, 1960, each third report will contain interpretive statements as well as data. Data for the report are prepared by the Division of Radiological Health, with the assistance of the Atomic Energy Commission, and other departments of the government. U. S. Department of Commerce, Office of Technical Service, Washington 25, D. C. Price, 50 cents an issue; $3 for six-month subscription.

WELDING FERROUS MATERIALS FOR NUCLEAR POWER PIPING—Welding techniques have been examined in view of the application of welding to nuclear power service. Report AWS D10.5-59 has been issued by the American Welding Society. Information is presented in this report on materials, welding procedures, selection of the proper welding procedure, acceptance and welder performance. Details of a number of welds are included. American Welding Society, 33 W. 39th St., New York 18, N. Y. Price, $1.50.

AIR POLLUTION IN CHARLESTON, S. C.— To evaluate the existing and potential air pollution situation, a guide has been made available on Air Pollution in Charleston, S. C. This is one of a group of studies done cooperatively by the Department of Health, Education and Welfare with state and local government agencies. For this report by Paul A. Kenline, write Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

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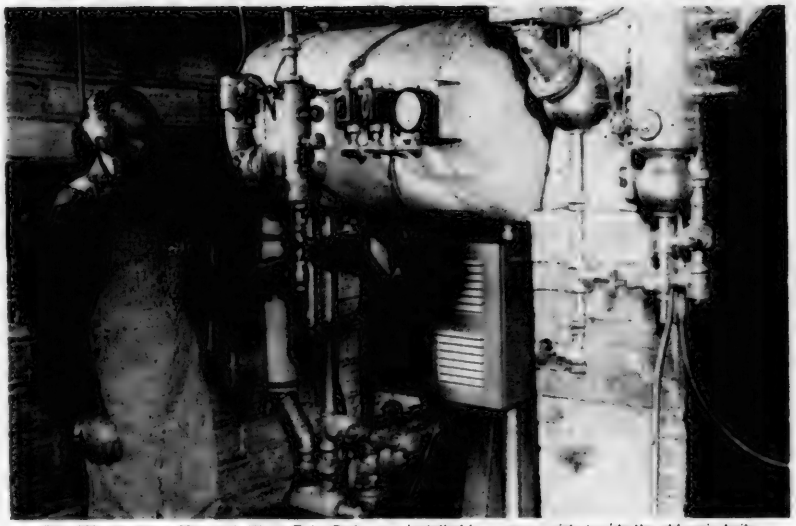
"NO MORE BOILER ROOM SPACE ...BUT WE NEEDED MORE STEAM"



This 125 bhp Vapor Modulātic Water Tube Boiler was installed in a narrow aisle beside the old main boiler.

The Kerr Conserving Company solved this problem with a Vapor Modulātic Water Tube Boiler

The Kerr Conserving Company of Portland, Oregon, makes berry juice concentrates used extensively by manufacturers of flavors and extracts, fruit syrups, beverages, etc.

A constant, dependable supply of high-pressure steam is essential to Kerr. Their concentrates are made to customers' specifications, and processing requires exceptionally careful control.

When the main boiler could no longer handle the steam load for their growing plant, an additional steam source became imperative.

In the words of Mr. Stuart Kerr:

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"Our installation has shown us a considerable saving in fuel cost, and given us greater production from our vacuum concentrating equipment."

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VAPOR MODULĀTIC WATER TUBE BOILERS

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Delivered fully assembled. Can be installed in hours—in spaces too small for ordinary boilers. No special foundation or stacks needed. Delivers full steam in five minutes from cold start.

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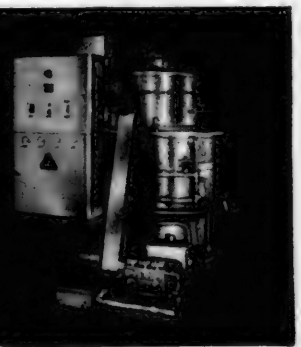
Pressures	5 to 900 psi
Fuel	Oil, Gas, or Combination
Floor Area (150 hp)	5 ft. x 8 ft.
Height (150 hp)	6 ft. 10 in.
Floor Load (max.)	150 lb / sq. ft.
Operation	Automatic



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3261 RANDOLPH STREET • BELLWOOD, ILLINOIS
ADVANCED SPRAY NOZZLE DESIGN FOR NEW DIMENSIONS IN CONTROL AND PERFORMANCE

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

ASSE MEETING—Annual meeting of the American Society of Sanitary Engineering, at the U. S. Grant Hotel, San Diego, Calif. S. Schwartz, secretary of the Society, 228 Standard Building, Cleveland 13, Ohio. . . . . **OCTOBER 9-14, 1960.**

AMERICAN INSTITUTE'S CONVENTION—Ninth annual convention of The American Institute of Supply Associations, Inc., to be held at the Americana Hotel, Bal Harbour (Miami Beach), Fla. Geo. T. Underwood, executive secretary of the Institute, 1628 Rhode Island Ave., N.W., Washington 6, D. C. **OCTOBER 23-26, 1960.**

ASA CONFERENCE—11th National Conference on Standards at the Sheraton-McAlpin Hotel, New York City. Secretary of the ASA, 10 E. 40th St., New York, N. Y. . . . . **OCTOBER 25-27, 1960.**

CONSULTING ENGINEERS COUNCIL—Semi-annual meeting of the Board of Directors of Consulting Engineers Council at the Penn-Sheraton Hotel, Pittsburgh, Pa. L. N. Spiller, 326 Reisch Bldg., Springfield, Ill. . . . . **NOVEMBER 10, 1960.**

BRI FALL CONFERENCES—Fall Conferences of the Building Research Institute, at the Shoreham Hotel, Washington, D. C. Harold Horowitz, Assistant Director for Technical Programs, BRI, 2101 Constitution Ave., Washington 25, D. C. . . . . **NOVEMBER 15-17, 1960.**

ARI ANNUAL MEETING—First annual meeting of the Air Conditioning and Refrigeration Institute, at the Hollywood Beach Hotel, Hollywood Beach, Fla. Geo. S. Jones, Jr., manager of ARI, 1346 Connecticut Ave., N.W., Washington 6, D. C. . . . . **NOVEMBER 18-22, 1960.**

POWER EXPOSITION — 24th National Exposition of Power & Mechanical Engineering, sponsored by the American Society of Mechanical Engineers, in conjunction with its annual meeting, to be held at the New York Coliseum, New York City. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. . . . . **NOVEMBER 28-DECEMBER 2, 1960.**

ASHRAE MEETING—Semi-annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. at the Conrad Hilton Hotel, Chicago, Ill. Secretary of the Society, 234 Fifth Ave., New York 1, N. Y. . . . . **FEBRUARY 13-16, 1961.**

HEATING AND AIR CONDITIONING EXPOSITION — International Heating and Air Conditioning Exposition, at the International Amphitheater, Chicago, Ill. E. K. Stevens, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. . . . . **FEBRUARY 13-16, 1961.**

NATIONAL SYMPOSIUM ON TEMPERATURE—Third National Symposium on Temperature—Its Measurement and Control in Science and Industry, sponsored jointly by the American Institute of Physics, Instrument Society of America, and the National Bureau of Standards, to be held in Columbus, Ohio. C. L. Roberson, ISA, 313 Sixth Ave., Pittsburgh 22, Pa. . . . . **MARCH 27-31, 1961.**

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Is there an all-purpose steam trap to meet all requirements? There is no existing single purpose trap to answer all trapping problems. Instead, Anderson offers four different trap designs, each engineered for a definite type of application.

For your general purpose applications, the answer is Super-Silvertop Steam Traps. Where fast heating-up is required, Anderson Heat-Kwik Combination Open Float or Thermostatic Traps are without an equal. Ideal for outdoor, freeze-proof installations, insist on our Quik-Flex Thermostatic Steam Traps. For draining condensate from steam or moisture from air and gas equipment, Anderson continuous flow type Float Traps are unbeatable.

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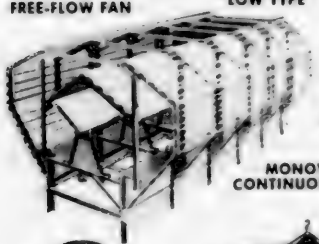
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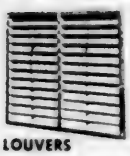
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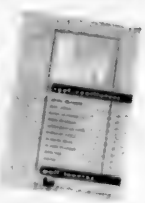
BURT'S complete ventilator line includes a type and size to put air to work most efficiently and economically for your specialized needs. BURT'S engineering skill and know-how from more than half a century designing and building ventilators is your assurance of satisfaction. Your inquiry will receive prompt and qualified attention.



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MEMBER POWER FAN MANUFACTURERS ASSOCIATION

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Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

DAYLIGHT AND VENTILATION .....
are both provided in one low-roof exhauster, the Penn Litex. Ideal for any building where inexpensive daylighting is necessary. Light is emitted through translucent fiber glass weathercaps and dampers that operate manually or automatically. Bulletin available.
Inside Front Cover — Item 200

STOP UNIT HEATER CORROSION .....
with properly sized Armstrong traps. Bulletin tells how to select and install traps for any type of unit heater. Also, steam trap book tells how to correctly size, install, and maintain steam traps for any pressure, temperature, load.
Page 1 — Item 201

ROOF-MOUNTED CONDITIONER .....
called the Atmos-Pak offers a broad range of applications. This year-round, pre-fabricated air conditioning system is primarily designed for the flat-roofed structure. In ten models of 5-35 tons. Air cooled. Ductwork eliminated. Information available from the manufacturer. Air Conditioning, Inc.
Page 2 — Item 202

SMOOTH-FIN COILS .....
marketed by Aerofin permit ample heat exchange capacity in limited space, permitting the use of high air velocities without turbulence or excessive resistance. Performance data laboratory and field proved. You specify at full published ratings. Information available.
Page 5 — Item 203

PNEUMATIC CONTROL SYSTEM .....
from the Powers Regulator Co. satisfied the unusual temperature requirements specified for the new Illinois-Psychiatric Institute. A catalog on pneumatic systems for hospitals is available.
Pages 6-7 — Item 204

VENT VALVES .. ..
for steam or water are offered by Hoffman in the most complete line. Engineered to meet the requirements of steam or water systems, heating or cooling, in residential, industrial, process work. Information available.
Page 9 — Item 205

A STANDARD HEATING PUMP .....
from Skidmore Corporation's extensive lines will meet the exacting requirements of any application. There is no need for a custom job. Three bulletins are offered.
Page 11 — Item 206

SMOKE STACKS .....
become true chimneys when you specify installation of a Field draft control. Units provide draft precisely controlled to the needs of gas combustion. Information is available.
Page 13 — Item 207

PACKAGE LIQUID COOLER .....
in which compressor flood-back protection is now standard equipment is offered by Bell & Gossett. With two complete refrigeration circuits, it has capacity reduction to 25%. All operative and safety controls installed and pre-wired. Complete data available.
Page 15 — Item 208

HEATING SPECIALTIES .....
made by Marsh Instrument Co. consist of uniformly good radiator valves, traps, and vents. Radiator valve and trap illustrated is truly packless, not just called packless. It has no packing whatever. Up to date heating specialties catalog offered.
Page 16 — Item 209

NEW STRAIGHT-FLOW CENTRIFUGAL
announced by Westinghouse (Sturtevant) is a fan with in-line air flow and the performance characteristics of the airfoil centrifugal fan. It is smaller by as much as 50%. New units are called Centriline fans. Catalog offered.
Insert 17-20 — Item 210

COPPER DRAINAGE SYSTEMS .....
fabricated from Anaconda copper tube permits wastes to flow freely. After years of use the inside is still smooth and rust-free. Many plumbing codes permit 3 inch diameter copper tube for soil line and vent. Information available from American Brass.
Page 21 — Item 211

NEW PROPELLER FAN LINE .....
announced by Trane for industrial and commercial applications is available in 266 standard combinations. Axial flow design meets a wide variety of needs from dissipating fog over dye vats, to ventilating commercial offices. Nine basic fan types. Specifications offered.
Pages 22-23 — Item 212

SPLIT-CASE PUMP .....
for the air conditioning industry is specifically designed by Fairbanks Morse for moderate cost installations. Design features include replaceable casing wearing rings, mechanical shaft seals, and sealed, pre-lubricated bearings. Bulletin is offered
Page 24 — Item 213

NEW AIRFOIL BLADED FANS .....
offered by American-Standard Industrial Div. exceed 90% efficiency. All units carry the AMCA certified rating seal. Ideally suited for general ventilation and industrial process applications. Bulletin available.
Page 25 — Item 214

PIPELINE INSULATION .....
from Johns-Manville brings the traditionally fine appearance and performance excellence of power plant work to general commercial and industrial installations. Brochure is offered.
Pages 26-27 — Item 215

SCALEFREE WATER HEATER .....
manufactured only by Patterson-Kelley provides all the hot water required for domestic service, comfort heating, and air conditioning re-heat. It will not scale because heat transfer occurs below the temperature at which minerals precipitate. Engineering data offered.
Page 28 — Item 216

REVOLVING HEATERS .....
made by Wing are unique in that they provide a sweeping flow of perfect heat. More economical than any other heating units. Workers are more comfortable and more productive. Standard units mounted 8 to 65 ft. Information available.
Page 29 — Item 217

Ad-Digest

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Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

GAS ABSORPTION REFRIGERATION .. manufactured by Carrier is the essence of simplicity and economy. It quietly and efficiently converts steam or hot water from a gas fired boiler into chilled water for air conditioning. Thus, boiler is used year round. Performance data, cost details, available.
Pages 30-31 Item 218

POWER ROOF EXHAUSTER ..... in the Jenn-Air Key Line has the lowest contour of any unit with circular discharge efficiency. It is 40% lower. Motor and drive are out of air stream. Maintenance-free spun aluminum housing. Bulletins on centrifugal and axial units offered.
Page 32 Item 219

PRACTICAL PIPING LAYOUT ..... detailed in Jenkins ad shows one-pipe heating system with individual thermostatic control of each area. Enlarged diagram and full description of this layout available.
Page 33 Item 220

PRIMARY AND SECONDARY PUMPING as conceived and developed by Bell & Gossett engineers both reduces pump horsepower and saves fuel by improving heat control where multiple buildings, or multiple zones within a building, are to be heated with circulated water. Booklet gives details.
Page 35 Item 221

NOISE CONTROL DATA ..... have been collected in exhaustive tests at the Barber-Colman modern sound laboratories, where engineers break down into eight octave bands the sound of air passing through Uni-flo diffusers. Data are available for specifying permissible sound levels. Literature available.
Pages 36-37 Item 222

QUIET FLUSH VALVES ..... made by Sloan are unequalled in quality at no extra cost. For buildings with excessive water pressure (in the range between 50 and 125 psi) flush valves can be equipped to operate quietly at only slight additional cost. Information available.
Page 38 Item 223

BASHFUL AIR-COOLED CONDENSER .. is so called because, with its vertical air discharge, it is so low and quiet that one hardly knows it's there. Product of Halstead & Mitchell, it is available in 5 to 100 tons. Bulletin is offered.
Page 39 Item 224

INDUSTRIAL AIR FILTER ..... from Research Products Corp. gives you more, costs you less, and provides many features for heating or air conditioning. Information is available.
Page 40 Item 225

STEEL PIPE ..... made by National Tube Division of United States Steel is known for its good distributor service, so important to contractor profits. Never a late delivery. Complete stock of pipe sizes available. Information available.
Page 41 Item 226

SUPPLY GRILLES ..... announced by Waterloo have flexible four-way adjustment, extruded aluminum louvers and are sturdily constructed. Double deflection grilles provide the flexibility for four-way adjustment. Single deflection grilles also offered. Comprehensive catalog gives data on company's complete line.
Page 42 Item 227

FORCED DRAFT BOILERS ..... made by Petro are just as efficient as they look, generating economical heat with oil or gas or both. Features include water-cooled rear furnace, quick reading control panel, large furnace tube, unobstructed flue doors, and single or dual fuel. Specifications offered.
Page 43 Item 228

CAST IRON BOILERS ..... made by Weil-McLain can be passed through an ordinary door, section by section, easily. Sectional boilers require less boiler room space, are corrosion resistant cast iron, are easily maintained, and have long lives. For gas, oil, heavy oil, combination fuel, or coal. Information is available.
Page 44 Item 229

UNIT HEATERS: FOUR TYPES ..... are made by Ilg. Whether you prefer all-electric, gas-fired, steam or hot-water units, this company can meet your preference with a variety of sizes and types. Full details on each type are contained in bulletins offered.
Page 45 Item 230

ASBESTOS-CEMENT PIPE BOOKLET ... offered by Johns-Manville contains 24 pages. Describes the layout and installation economies, wide variety of fittings, diameters, and lengths, its adaptability to venting service. Never needs painting, easily cut, resists most gases, fumes, and dusts.
Page 46 Item 231

DUAL-DUCT CONDITIONING ..... by Buensod-Stacey is unobstrusive: cooling in summer, warming in winter, and always maintaining proper conditions. But no visible duct or room units. There is never a balancing problem, thanks to automatic volume control. Information available.
Page 47 Item 232

NEW MIXING BOXES ..... by Air Devices represent a major development in constant control and distribution of high velocity tempered air. Type O Agitair boxes eliminate all troublesome linkages and pivots. Catalog offered.
Page 48 Item 233

COPPER WATER TUBE ..... made by Reading is ideal in general plumbing, heating systems, drainage waste and vent lines, sprinkler and irrigation systems, and rural installations. Soft temper tubes can be curved around corners and obstructions but are rigid enough not to sag without support. Complete catalog offered.
Page 49 Item 234

BOILER'S TWO BEST FRIENDS ..... are the McDonnell pump control and low water cut-off, built to stand up under the temperatures and pressures such control encounters; and the McDonnell make-up water feeder, which is sturdily constructed to maintain the required water level in receiving tanks. Information available.
Page 51 Item 235

CENTRAL CONDITIONING ..... with Thermal Engineering units, is being installed by an ever increasing number of banks because of the units' reputation for quality and dependability. Ready accessibility of internal components is combined with rugged construction. Complete catalog offered.
Page 52 Item 236

PLATED PLUMBING PARTS ..... from Jay R. Smith are now regularly furnished with Iridite gold bright protective plating for more protection from rust and corrosion. On all Smith carriers, cleanouts, interceptors. Information available.
Page 53 Item 237

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement. All advertisements are digested here except those that are received too late for inclusion in this listing.

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

PROBLEM-SOLVING MOTORS .....
by Wagner end voltage drop and line disturbances caused by starting big motors. Increment motor-starter combinations limit the inrush of starting currents. Bulletins available.
Page 54 Item 238

FLOOR DRAIN WITH BUCKET .....
made by Wade has no equal. Features heavy weight, wedge type clamping, triple drainage, 79.6 sq in seepage flange, and six large trapazoidal weep holes. Information available.
Page 55 Item 239

GALVANIZED STEEL SHEETS .....
called Softite by Wheeling Steel Corp. can be bent, hemmed, scribed, punched, formed, notched, drawn, welded, crimped, and sheared. Information is available.
Pages 114-115 Item 240

PACKAGED BOILERS .....
made by the Babcock & Wilcox Co. are known for their dependability, cleanliness of operation, high fuel economies, flexibility, rapid response to demand, and maximum capacity in minimum space. Nation-wide service organization. Information available.
Page 117 Item 241

AIR COOLED CONDENSERS .....
are of rigid, heavy-gage construction by McQuay for durability and low noise level. Aircons, in 13 sizes to 85 tons in a single unit, are available in horizontal as well as vertical air flow models. Information available.
Page 119 Item 242

NEW ROOM THERMOSTAT LINE .....
offered by Barber-Colman includes standard, cataloged variations to meet every requirement. Select the exact thermostat you need: 24, 120, 240 volts; night depression, heat anticipation; add-on construction (matching subbases to add manual switches); special cover kits. Bulletin available.
Pages 122-123 Item 243

IN-DUCT FAN .....
made by DeBothezat is now so constructed that you can pull the fan wheel or motor while the Bifurcator fan remains in the duct. It speeds up inspection and slashes maintenance and downtime costs. Literature available.
Page 125 Item 244

BURNER CATALOG .....
offered by Power Flame Div., Inc., includes a complete range of models and sizes in atmospheric burners, power burners, and combination burners. All designed for lowest installation and maintenance cost.
Page 126 Item 245

ALNOR PYROCON .....
permits you to set thermal expansion valve of air conditioning system in less than a minute. It eliminates the slow thermometer method of determining temperatures in the system. Recommended Model 4000 has temperature range of 0-300 deg. F. Bulletin available.
Page 127 Item 246

ROOF VENTILATORS .....
in 12 different types are illustrated in this month's ad by Western Engineering & Mfg. Co. Information on these ventilators is available.
Page 128 Item 247

DIAMOND DRILLING SYSTEM .....
offers its latest, the Mole, Jr. Model "R", added to the Molco line. It will cut clean, smooth holes in reinforced concrete, granite, marble, tile and asphalt. Catalog lists drilling machines for all concrete drilling jobs.
Page 129 Item 248

STUDGUN .....
offered by Ammo Products is a precision engineered tool designed for fastening wood or metal to concrete and steel. One model fires all pins. Exclusive insured angle fire control while using barrel extension, and fixed close-up and center position guards. Equipment catalog available.
Page 129 Item 249

NON-SCALD SHOWER VALVE .....
from Symmons Engineering Co. is called America's favorite. Self-cleaning action prevents clogging and saves water. Literature is available.
Page 130 Item 250

POWER-DRAFT UNITS .....
designed for residential, commercial and industrial applications are offered by Quickdraft Corp. They provide maximum heating or exhausting efficiency at lowest cost. Engineering data bulletin is available.
Page 131 Item 251

DUCT TAPES .....
made by Arno will modernize any unsealed duct system, increasing air flow at registers considerably. Tape sticks instantly and holds permanently. Flame-resistant, non-flame resistant types available. Sample offered.
Page 132 Item 252

SMALL BOILERS—BIG OUTPUTS .....
is the boast of Cleaver-Brooks whose packaged boilers help solve many unusual installation problems: Low head room; shortage of ground-level space. Penthouse installations completely eliminate ground-level use. Sizes through 600 hp. Boiler room templets offered.
Page 133 Item 253

ZONE CONTROL VALVE .....
manufactured by Heat-Timer Corp. is constructed to last. The valve's packless design means no friction, no wear, and no adjustment. Brochure is offered.
Page 134 Item 254

FLEXIBLE PIPE CONNECTORS .....
for heating, air conditioning and piping applications will be handled by a special new division of Allied Metal Hose Co. Information and the name of the division representative of your area are available.
Page 135 Item 255

DRY AND CLEAN AIR .....
at the right temperature is a product of the Niagara method of air conditioning using Hygrol liquid absorbent. Two bulletins are offered.
Page 136 Item 256

FLEXIBLE HOSE .....
made by Flexaust of high quality metal and neoprene coated fabrics has proven lower in installation costs and provides exceptional abrasion resistance, noise absorption and easy relocation of hoods and machines. Full details available.
Page 136 Item 257

SUBMERSIBLE SUMP PUMP .....
built by Weil for submerged operations and priced lower than many conventional units is UL approved. Can be installed through 15-inch opening. If current fails, moisture cannot damage. Rugged switch. Bulletin available.
Page 137 Item 258

AIR VELOCITY METER .....
is a single instrument which tells both air velocity and static pressure. Reads directly in feet per minute and inches of water, checks all velocities from 400 to 10,000 fpm, reads static pressures from 0 to 10 inches of water. Literature and prices available from F. W. Dwyer.
Page 138 Item 259

Ad-Digest

INQUIRY SERVICE FOR ADVERTISED PRODUCTS

Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail a prepaid postcard, either of two that appear on the yellow page following, to request further information from manufacturers.

DIRECT-FIRED HEATERS ..... in the Reznor line are available in more types and sizes than any other. Three control options, propeller or blower fans, 25,000 to 30,000 Btuh. Duct furnaces to 300,000 Btuh. Automatic vent exhauster permits unit heater installation almost anywhere. Catalog offered.
Page 139 Item 260

MULTI-PERSON SHOWERS ..... by Bradley are five showers in one unit. Facilities can now be installed quickly, at low cost and in small space. Used by thousands of students in schools and colleges. Bulletin available.
Page 140 Item 261

PACKAGE UNITS ..... such as those made by Iron Fireman remove the uncertainty from heating boiler installation and operation, according to chief engineer of the Mid-Island Hospital, Bethpage, L. I., N. Y. Information is available.
Page 141 Item 262

DIAL THERMOMETERS ..... made by Palmer are available in three mercury-actuated types to suit any requirement: Rigid stem model has tapered bulb, is interchangeable with standard industrial thermometer separable socket; wall mounted unit is adjustable to easy reading condition; flush mounted unit. All three have 4½ inch dial face. Information available.
Page 142 Item 263

HIGHER, WIDER, SCAFFOLD ..... made by Baker for portability and durability; uses standard Baker scaffold components. Big 28 sq ft working platform area. Adjusts in 3-inch increments. Assembles in 90 seconds. Information available.
Page 142 Item 264

INDUSTRIAL EXHAUST FANS ..... offered by Lehigh handle dust-laden air and gases, paper shavings and the like, without clogging. Uniquely designed wheel is responsible. All-welded mild steel wheels of the long shaving design solve difficult exhaust problems. Universal housing permits adjustment to different field conditions. Full details in bulletin available.
Page 143 Item 265

HEATING SAVINGS CALCULATOR .... is offered by Wanson Corporation and deals with use of Thermobloc direct-fired warm air heaters in industrial applications. It tells number and size of heaters needed for different areas, and shows dollar savings. Company requests that you write on your company letterhead for this calculator.
Page 144 Item 266

SPIRAL AIR DUCT ..... offered by Wiremold is the only duct that permits connection to metal fittings without clamps. Flat spiral construction accepts No. 7, half-inch drill screws. Just two or three keep duct securely in place. New folder offered.
Page 144 Item 267

VERTICAL END-SUCTION PUMPS ..... by Aurora save space and reduce costs. Capacities to 1800 gpm, heads to 320 ft. Close-couple, vertical mounting provides extreme compactness. Flanged suction mounting. Bulletin available.
Page 145 Item 268

VACUUM THERMOSTAT ..... made by Sterling, Inc., is simple and trouble-free, assuring efficient, economical steam trap operation. Thermostat compensates for pressure changes. While vacuum in thermostat remains intact, traps require no attention other than normal maintenance. If vacuum is lost, thermostat closes trap and radiator. Bulletin available.
Page 146 Item 269

UNIT HEATERS ..... by Young are offered for every requirement. Four catalogs are offered, each giving capacities and diagrams for various types: Vertiflow, horizontal, cabinet, and gas-fired unit heaters
Page 147 Item 270

POSITIVE SEALING INDICATORS ..... made by Allin Mfg. Co. proven on thousands of production line installations have one piece extension gasket for positive sealing and fool-proof assembly. Six sizes. Complete line catalog available.
Page 148 Item 271

ACCESS SADDLE VALVE ..... by Watsco is a truly hermetic tube-piercing valve that can be soldered or brazed on refrigerant lines without removing the refrigerant. Complete with silver solder pre-form, available in five OD tube sizes. Information available.
Page 148 Item 272

WATER TUBE BOILER ..... made by Vapor Heating Corp. is compact, efficient and economical. These Vapor Modulatics for process, power and heating are delivered fully assembled and can be installed in hours in spaces too small for ordinary boilers. Full steam in five minutes. Bulletins available.
Page 149 Item 273

SPRAY NOZZLES ..... and all related accessories for humidifying are available from Spraying Systems Co. For industrial installations of every size. Everything but the piping, wiring and compressor. Bulletin is available.
Page 150 Item 274

PRESSURE BURNERS ..... for dual-fuel, gas, or oil are offered by Synchronous Flame. Designed for hard-to-fire jobs; all types of boilers, warm air furnaces, and ovens. Many standard features which are extras on other burners. Detailed information offered.
Page 150 Item 275

FLOATS ..... for any liquid level control problem are available from Arthur Harris & Co. They meet requirements of high temperature, high pressure, or highly corrosive service. Catalog is offered.
Page 150 Item 276

AN ALL-PURPOSE STEAM TRAP ..... does not exist. Instead, V. D. Anderson offers four different trap designs, each engineered for a definite type of application. Engineering catalog is offered.
Page 151 Item 277

VENTILATORS ..... manufactured by Burt includes wide line of roof units and wall louvers. Data book offered. Company's engineering skill and know-how based on more than a half-century of experience. A type and size for all specialized needs.
Page 152 Item 278

NEW PACKAGED FAN CATALOG ..... available from Clarage details its ready-to-run units for supply and exhaust jobs ranging to 25,000 cfm. Adjustable in the field to 8 discharge directions. Available for both outdoor and indoor installations.
Inside Back Cover Item 279

SERIES T-800 THERMOSTATS ..... offered by Johnson for control of air, steam, and liquid, are designed for air conditioning, heating, ventilating, and industrial applications requiring accurate control at low sensitivities. They are widely used for the control of temperatures in air ducts or chambers, in tanks, and in pipes. Bulletin available.
Back Cover Item 280

Advertisements in this issue are summarized on the Ad-Digest pages preceding this page. If you want more information on advertised products, locate the Digest item number of that advertisement, circle the item number on either of the post-cards provided below.

Use the post-cards below

to obtain catalogs mentioned in this issue or further information on products described or advertised in this issue.

1. Circle item numbers of new equipment and catalog descriptions
2. Circle item numbers of advertisements as shown in the Ad-Digest on the preceding pages
3. Mail . . . we'll do the rest

CIRCLE FOR NEW EQUIPMENT AND LITERATURE INQUIRIES

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Please print

NAME .....

TITLE .....

COMPANY OR FIRM .....

NATURE OF FIRM'S BUSINESS .....

STREET .....

CITY .....**ZONE** ....**STATE** .....

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THIS CARD VOID AFTER JAN. 1, 1961

October '60

CIRCLE FOR NEW EQUIPMENT AND LITERATURE INQUIRIES

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October '60

Use the post-cards below

to obtain catalogs mentioned in this issue or further information on products described or advertised in this issue. See preceding page for instructions.

FIRST CLASS
Permit No. 53
New York, N. Y.

BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

Air Conditioning, Heating and Ventilating
93 WORTH STREET
NEW YORK 13, N. Y.

READERS' SERVICE DEPT.

FIRST CLASS
Permit No. 53
New York, N. Y.

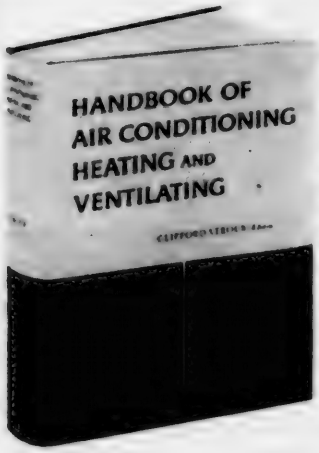
BUSINESS REPLY MAIL
No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

Air Conditioning, Heating and Ventilating
93 WORTH STREET
NEW YORK 13, N. Y.

READERS' SERVICE DEPT.

BOOKS LIKE THESE ARE RELIABLE TOOLS THAT CAN HELP YOU IN YOUR WORK!



HANDBOOK OF AIR CONDITIONING, HEATING AND VENTILATING

Edited by Clifford Strock

Completely new book containing thousands of facts, figures, data and principles; hundreds of charts, tables and maps. Answers problems you face every day in your work. Subjects treated thoroughly include: Air Conditioning, Air Handling, Building Heat loss, Climatic Data, Combustion, Degree-Days, Dual Duct Design, Dust Collection, Fuel Estimating, High Velocity Air, Mathematics, Motors, Piping and Plumbing, Psychrometry, Radiator Heating, Refrigerants, Service Hot Water, Solar Data, Steam Flow, Ventilation, Warm Air Heating, Terminology and a complete cross index. **1094 Pages, 7¾" x 10¾", 598 Charts, Maps, Illus., 518 Tables, $15.00.**

SUMMER AIR CONDITIONING

by S. Konzo, J. R. Carroll and H. D. Bareither

Training text and reference book on residential air conditioning for all who design, sell, install or operate these systems. Diagrams show mechanisms and principles of operation. Information understandable to beginner. Tells *how* and *why* things are done the way they are and *what* makes equipment operate the way it does. **560 Pages, 266 Illus., $8.00.**

WINTER AIR CONDITIONING

by S. Konzo, J. R. Carroll and H. D. Bareither

Does for hydronic and warm air heating what *Summer Air Conditioning* does for cooling. **640 Pages, 317 Illus., $8.00.**

COMBINATION OFFER

Both of the above Air Conditioning books, $15.00.

DESIGN OF AIR CONDITIONING SYSTEMS

by F. W. Hutchinson

115 full-page charts solve problems of air conditioning system design involving cooling load, duct design, psychrometrics, solar energy, comfort conditioning, panel cooling, etc. For each chart the engineering and mathematical background plus design example and solution are given. **336 Pages, 118 Illus., $7.00.**

DESIGN OF HEATING AND VENTILATING SYSTEMS

by F. W. Hutchinson

96 full-page charts solve problems of heating and ventilating involving load determination, duct design, panel heating, solar heating and combustion analysis. Companion book to Design of Air Conditioning Systems. Same methods to explain and solve problems are used. **320 Pages, 96 Charts, $7.00.**

COMBINATION OFFER

Both of the above books by Prof. F. W. Hutchinson, $12.50.

PIPEFITTERS HANDBOOK

Enlarged Second Edition

by Forrest R. Lindsey

Written by a pipefitter for pipefitters. Answers problems of pipe bending, layout and installation directly. Data are presented so that problems of fitting pipe around bends and through changes of direction at prescribed angles require only picking a number and doing the job. All techniques, such as bending, welding and use of screwed fittings are covered.

CONTENTS

Pipe Bending — Screwed Offsets — Mitered Joints — Dimensions — Screwed Fittings—Butt Welding Fittings—Flanges and Flanged Fittings—Solder Joint Fittings—U-Bolts—Spacing of Hangers—Water in Pipes—Pipe Expansion—Identification—Contents of Tanks—Valves—Plastic Pipe—Metals—Steam—Mathematical Data—Measures—Conversion Tables—Trigonometry—Field Layout of Angles—Dictionary.

416 Pages
248 Illustrations

$6.00

FIRST CLASS
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NO POSTAGE NECESSARY IF MAILED IN UNITED STATES

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AIR CONDITIONING, HEATING and VENTILATING
93 WORTH STREET
NEW YORK 13, N. Y.

BOOK DEPT.

PUT THE FACTS AND FIGURES YOU NEED AT YOUR FINGERTIPS—WITH BOOKS!

HIGH TEMPERATURE WATER SYSTEMS

by Owen S. Lieberg

A complete and concise exposition of the principles, design, installation and application of high temperature water. Written by the designer of many of the world's largest systems. For engineers, operators, and owners. **224 Pages, 109 Illus., $6.50.**

SNOW MELTING

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Correct, tested steps in planning, designing, building and operating snow melting systems. Time saving charts, tables and graphs give data and simplify every step. **224 Pages, 189 Illus., $4.50.**

FLOW AND FAN

by C. H. Berry

Covers moving air through ducts, fan selection and control, duct arrangement, system characteristics, flow analysis. Basic data and methods used to calculate system resistance. Practical information for selecting a fan for any duty. **232 Pages, 84 Illus., $4.00.**

ELECTRICAL TESTING AND TROUBLESHOOTING

by P. T. Green

How to locate and correct faults in circuits of all kinds—controllers, motors, transformers and transmission lines. Field tested procedures. An ideal training and reference book. **200 pages, 100 illus., $5.00.**

DESIGN OF PLUMBING AND DRAINAGE SYSTEMS

by L. Blendermann

Detailed, illustrated guide covering modern plumbing practice and design. Basic problems as well as modern specialized topics are discussed. **328 Pages, 201 Illus., $7.00.**

FLUID FLOW IN PIPES

by C. H. McClain

How to solve problems involving the flow of liquids and gases through pipes. How to handle viscosity, friction, heat, and other factors expressed in various dimensional systems. Worked-out problems show applications of principles. **124 Pages, 18 Illus., $4.00.**

PLANT AND PROCESS VENTILATION

by W. C. L. Hemeon

Design factors and data that can be applied to any situation. Principles are clear, logical. Shows how to estimate exhaust requirements for dust and fume producing processes, hot or cold. Principles of general ventilation and bulk materials handling. **448 Pages, 172 Illus., $9.00.**

FUEL OIL MANUAL

by P. F. Schmidt

Properties, selection, storage, handling, and burning of all grades of fuel oil. How to assure uniform quality, efficient combustion, maximum value. Additives, treatments, troubles and remedies. **176 pages, 34 tables, $4.50.**

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS

Completely revised 3rd Edition

by John L. Alden

This classic text on how to design, build and buy industrial exhaust systems has been brought up-to-date to meet modern standards of industrial environment. Developments and advances in devices and techniques described. **256 Pages, 137 Illus., $6.00.**

Three Bargain Paperbacks

These alltime winners in ACH&V's popular Reference series are now available. Ideal for classroom or company purchase. Note quantity discounts below.

SERVICE HOT WATER

by Fred M. Reiter
Fuel Engineer, The Dayton Power and Light Company, Dayton, Ohio

An exceptionally comprehensive treatment of the subject, including methods and equipment, piping, flues, corrosion and fuel cost comparisons, with special emphasis on estimating data for all types of applications presented in 65 tables, 17 graphs and 13 sketches.

40 Pages Paper Bound $2.00

THE DEGREE-DAY

by Clifford Strock
Editor, Air Conditioning, Heating and Ventilating

What the degree-day is, extensive degree-day tables for 1212 U.S. localities, 42 cities in Canada, 16 in Alaska, how the degree-day is used for comparing operating results of heating plants, and how it is used for estimating fuel consumption for building heating, together with ten maps in color.

40 Pages Paper Bound $2.00

BASIC THERMODYNAMICS OF HEATING AND COOLING SYSTEMS

by John F. Sandfort
Associate Professor of Mechanical Engineering, Iowa State College

Those thermodynamic fundamentals which apply to heating and air conditioning engineering are reviewed, beginning with elementary concepts and developing more complex principles with examples of their application. This will be a refresher for engineers in practice as well as a guide for those who are in training in the fields of air conditioning, heating, or ventilating.

20 Pages Paper Bound $2.00

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NAME .....

COMPANY .....

COMPANY ADDRESS .....

CITY .....ZONE .....STATE .....

HOME ADDRESS .....

CITY .....ZONE ....STATE .....

(please fill in home address only if you want books sent there) H/10/60

CLARAGE

"Packaged" fans . . . ready-to-run units for supply and exhaust jobs ranging to 25,000 CFM. Adjustable in-the-field to 8 discharge directions. Available for both outdoor and indoor installations. Send for 36-page catalog containing complete information or contact nearest Clarage sales engineering office.

CLARAGE FAN CO., 619 Porter St., Kalamazoo, Mich.

Please send your Ready Unit Catalog 517.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

Dependable equipment for making air your servant

CLARAGE FAN COMPANY

Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

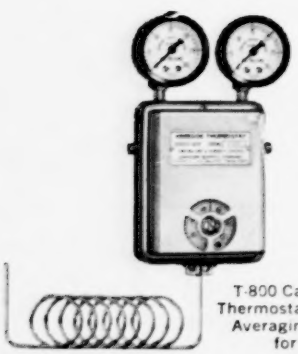
JOHNSON SERIES T-800 THERMOSTATS

FOR CONTROL OF AIR, STEAM, AND LIQUIDS

T-800 Remote Bulb Capillary Thermostat for Air, Steam, and Liquids.

- Series T-800 thermostats are designed for air conditioning, heating, ventilating, and industrial applications requiring accurate control at low sensitivities. They are widely used for the control of temperatures in air ducts or chambers, in tanks, and in pipes.
- Choice of elements:
  1. Liquid filled capillary with remote bulb. Standard temperature range from –30F to 300F. Fully compensated stainless steel capillaries available from 8 to 85 feet. Non-compensated copper capillaries furnished in 4 and 6 ft. lengths. Also available with 8-ft. averaging bulb.
  2. Rigid stem liquid filled immersion element. Temperature range from –30F to 300F.
  3. Rigid stem liquid filled insertion element. Temperature range from –30F to 300F.
- All elements are fully interchangeable.
- Remote bulb may be located at any point above or below thermostat.
- Proportional or two-position action.
- Direct or reverse acting. Simple change of pivots converts from direct to reverse acting.
- Sensitivity or differential: from $\frac{1}{8}$ to 5 psi per degree F; 2 to 30 degrees F.
- Uniform sensitivity and dial graduations over entire range of operation.
- Used as standard thermostat and as a master controller for readjusting the control setting of a submaster thermostat.

For more information write for bulletin T-800. Johnson Service Company, Milwaukee 1, Wisconsin.



T-800 Capillary Thermostat with 8' Averaging Bulb for Air.

T-802 Rigid Stem Insertion Thermostat for Air.

T-804 Rigid Stem Immersion Thermostat for Liquids.

OUR 75TH YEAR

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885